GEODYN Documentation
Volume 3

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Contents

1 INTRODUCTION

Specific problems to be solved by the GEODYN II program are defined by input cards. These cards fall into two categories: The Global Set and the Arc Set. The Global Set contains information which is common to all of the arcs being processed. Each Arc Set contains information defining its arc. Therefore one or more Arc Sets could be present in the GEODYN-II input.

The Global Set consists of four groups in the following order: The first group is the mandatory Run Description on three cards with no defined format. The second group is the set of Option cards which may be used to define and/or estimate conditions which are common to all the arcs being processed. The third group is the optional Station Coordinate Subgroup which may be used to alter GEODYN II's set of tracking stations. The last group in the Global Set is the mandatory Global Set Termination card.

The Arc Set also has four groups in this order: The first group is the mandatory Arc Description on three (or more) title cards well as mandatory cards to describe the reference coordinate system and time and spacecraft parameters in this arc. The second group is the set of Arc Option cards which may be specified to make use of GEODYN II's individual arc capabilities. The third group is the Data Selection/Deletion Subgroup which may be used to edit input observations. The Data Selection/Deletion Subgroup should not be present in orbit generation runs. In data reduction runs, the use of DATA and SELECT cards is mandatory (see individual card for explanation). The last group in the Arc Set is the mandatory Arc Set Termination card.

2   INPUT CARDS OVERVIEW

The Global Set begins with a mandatory subset of three cards on which the user may record any descriptive information concerning the job.

The Option cards which follow, are presented in the document in alphabetic order but not necessarily used in this order unless otherwise specified in the individual case. Information which applies to all arcs could be included in one of the following categories of input cards:

1. A forcing function description and/or condition input card such as:

   - cards which define the gravitational model
   - request application and/or modifications of the Earth or planet gravitational potential,
   - request application and/or modifications of the Earth tide model.
   - request estimation of the gravitational coefficients.

2. Observation modeling descriptive cards such as:

   - cards which require application of various models
   - modify and/or estimate parameters which describe the observation equation (polar motion, solid Earth tides, ocean tides and tectonic plate motion.)

3. Cards specifying models which describe tracking measurement corrections such as:

   - antenna or reflector offsets from the spacecraft center of gravity
   - choice of tropospheric refraction model

4. Cards which affect observation modeling.

5. Input cards controlling the format and the quantity of the listings and the printout.

The Global Set continues with the STAPOS subgroup. Input cards in this subgroup set conditions for solution, constraints and correlations pertaining to stations with available data. The STAPOS subgroup also includes cards containing station positions, geodetic information and planetary parameters for extra terrestrial stations. If the STAPOS subgroup is present it must be terminated with an ENDSTA card.

The Global Set of input cards ends with the mandatory card ENDGLB which also specifies the maximum number of Global parameter estimation iterations and the number of TITLE cards in each arc.

The Arc Set begins with a number of TITLE cards which are mandatory for each run on which the user may include any information pertaining the arc. Information to be included on the rest of the mandatory card subgroup is the coordinate system of integration, number of arc iterations, spacecraft information, start and end time of orbit integration and introduction of the components of orbital elements.

The next subgroup of the Arc Set is a group of Option cards which affects:

1. The solution itself with information such as:

   - editing multiplier
   - integration order/step size
   - apriori variance/covariance matrix for the satellite elements.

2. The observation equation with information such as:

   - measurement bias and
   - station timing bias

3. The force model with information such as application and/or adjustment of:

   - general acceleration
   - drag coefficient
   - solar radiation pressure

4. The output with information such as:

- output of E or V-matrices

- output required on specified units

- residual file output

- normal point generation control

The next subgroup in the Arc Option cards is called the Data Selection subgroup and it is introduced by the DATA card. This card must be present with any arc requiring data reduction. The cards which follow DATA are very important to the user as an editing tool. One can specify Data Selection and Deletion time intervals, input of meteorological data, application of constant bias observation correction, request data preprocessing and specification of weighting and editing sigmas.

The Data Selection subgroup ends with an ENDARC card which also denotes end of the arc. In case more than one arc are required, the user should start with a new set of Arc TITLE cards.

A detailed description for each card in the Global and Arc Sets is given in the following section. That includes format and function description, default values and units and description of the consequences in case any of these cards is ommitted.

Finally the card ENDALL denotes the end of all arcs and the end of input cards.

2.1 A GUIDE TO GEODYN II INPUT CARDS

```
SUBJECT        CARD       DESCRIPTION                          TYPE
--------------------------------------------------------------------------
ADJUSTMENT     CORREL : Correlation between station cooordinates   STAPOS
CONTROL         FIXED  : Specify fixed stations                    STAPOS
               ADJUSTED: Adjusted stations/ Sigma for stations     STAPOS
               CONSTADJ/                                           STAPOS
               CONSTEND: Constrained stations control              STAPOS
                NORMPV : Normal point orbit adjustment control      ARC
                         and a-priori variance input.
                VARCOV : A-priori var/covar matrix for the          ARC
                         satellite elements.
                 SIGMA : Observation correction editing sigma      DATA

ALBEDO          ALBEDO : Application of Earth radiation pressure    ARC

ALTIMETRY        ALTIM : Altimetry related input.                  COMMON
                SSCOEF : Spherical harmonics coefficients for      COMMON
                         static sea surface topography model.
                SSTOPO : Max degree and order for static sea       COMMON
                         surface topography model.
                 OLOAD : Ocean loading using the expanded tide     COMMON
                         model.

ANTENNA /        DELAY : Transponder delay                         COMMON
INSTRUMENT      OFFSET : Antenna offset/laser reflector offset     COMMON
               INSTRMNT: Parameters for tracking instrument        STAPOS

ATMOSPHERIC     DRAG   : Drag application / estimation of drag      ARC
EFFECT                   coefficient.
                ATMDEN : Atmospheric density model.                COMMON
                FLUX   : Modify flux values.                       COMMON
                REFRAC : Tropospheric model.                       COMMON
                THRDRG : Thermal Drag model (Lageos)                ARC

BIASES          EBIAS  : Pass by pass measurement biases            ARC
                MBIAS  : Measurement biases -  Station              ARC
                         timing biases.
                PBIAS  : Pass by pass measurement or timing         ARC
                         biases.
                OBSCOR : Constant bias applied as observation       ARC
                         correction.

CONSTANTS       VLIGHT : Speed of light                            COMMON

COMPUTER        CYBG2E : GEODYN IIE on CYBER (default).            COMMON
SELECTION       IBMG2E : GEODYN IIE on IBM.                        COMMON


SUBJECT        CARD       DESCRIPTION                          TYPE
--------------------------------------------------------------------------
DATA            SELECT : Data times/satellite/station/mtypes       DATA
SELECTION       DELETE : Data times/satellite/station/mtypes       DATA
                METDAT : Override met.data information              DATA
                OBSCOR : Constant bias observation correction       DATA
                PREPRO : Data preprocessing.                       DATA
                 SIGMA : Observation weighting and editing sigma.  DATA
```

```
GENERAL          REL300 : Relativistic corrections                      ARC
RELATIVITY

GENERAL          ACCEL  : Application/adjustment of general             ARC
ACCELERATION              acceleration.
                 ACCELT : Application/adjustment of general             ARC
                          acceleration in 3 dimensions.
                 ACCEL9 :                                                ARC

GEOPOTENTIAL EARTH   : Modifies the Earth's gravitational           COMMON
                          potential/Earth's constants.
               GEODETIC: Overrides the Earth's parameters for         STAPOS
                          certain stations
                 GCOEF  : Modification/estimation of the              COMMON
                          coefficients in the Geopotential model
                 GCOEFS : Modification/estimation of C coeff.         COMMON
                 GCOEFC : Modification/estimation of S coeff.         COMMON
                 GEOPOL : Application of polar motion to the          COMMON
                          Earth's gravitational potential.
                 GRVEPO : Time depended gravity time intervals.       COMMON
                 GRVTIM : Estimation of time dependent gravity        COMMON
                          coefficients.
                 GXPAND : Estimation of a range of geopotential       COMMON
                          coefficients.
                 PLANET : Third body gravitational potential.         COMMON
                 TOLS   : Maximum degree of geopotential for          COMMON
                          variational equations.

INTEGRATION    REFSYS : Specification of coordinate system            ARC
INFORMATION              for integration.
                 EPOCH  : Specification of times for integration       ARC
                 SLAVE  : Sets of satellites/times for                 ARC
                          integration
                 STEP   : Changes integration order and stepsize       ARC

INTER -          TRKBDY : Defines tracking body                       COMMON
PLANETARY        PLANET : Third body gravitational potential          COMMON
               EXTRAGEO: Planetary shape parameters for planetary    STAPOS
                          stations.

NORMAL           NORMPT : Computation and output of normal points      ARC
POINTS           NORMPV : Normal point orbit adjustment control        ARC


SUBJECT        CARD     DESCRIPTION                                    TYPE
-----------------------------------------------------------------------------
OUTPUT         NOLIST : Interrupts GIIS input listings                 ARC
CONTROL        LIST   : Negates effect of NOLIST                       ARC
               OBSVU  : Controls residual printout for all arcs,       ARC
                          preprocessing correction output and
                          measurement partials output
               PARFIL : Output partial derivative files                ARC
               PLATIM : Station coordinate printout at                 ARC
                          requested times. (Plate tectonics
                          option , see PLATE)
               PRINTVU: Controls output of GIIS and GIIE on            ARC
                          UNIT06.
```

```
              PUNCH   : Requests punched output
              TERMVU  : Output on UNIT09 (80 characters/line)       ARC
              EMATRX  : Output E matrix/V matrix                     ARC
              ORBFIL  : Output trajectory file on specific          ARC
                        units
              ORBTVU  : Trajectory output on UNIT06                 ARC
              RESIDU  : Residual file output on UNIT19              ARC
              NORMPT  : Computation and output of normal points     ARC


PLATE         PLATE   : Tectonic plate motion.                   COMMON
TECTONICS     PLATIM  : Reference date for station coordinates   COMMON
                        for tectonic plate motion.


POLAR MOTION  POLE    : Modifies polar motion and A1-UT1         COMMON
                        values.
              POLDYN  : Dynamic polar motion.                    COMMON
              POLKF   : Figure axis for dynamic polar motion.    COMMON
              POLEUT  : Modification/adjustment of true pole     COMMON
                        coordinates and A1-UT1 time differences


STATISTICAL   EDIT    : Editing multiplier/initial RMS.            ARC
CONTROL       SIGMA   : Observation correction editing sigma       DATA


SIMULATIONS   SIMDAT  : SIMULATED DATA SUBGROUP                     ARC


SOFTWARE      VECOPT  : Vector optimization, core allocation     COMMON
OPTIMIZATION            control.


SOLAR         SOLRAD  : Application/adjustment of solar             ARC
RADIATION               radiation pressure.


SPACECRAFT    SATPAR  : Spacecraft related parameters              ARC
RELATED       SLAVE   : Sets of satellites/times for              ARC
PARAMETERS              integration
              ELEMS1  : Initial state vector (first 3             ARC
                        components).
              ELEMS2  : Initial state vector (last 3              ARC
                        components).
              VARCOV  : A-priori variance-covariance for          ARC
                        satellite elements



SUBJECT       CARD     DESCRIPTION                                 TYPE
--------------------------------------------------------------------------
SPEED OF      VLIGHT : Speed of light                           COMMON
LIGHT


STATIONS      STAPOS  : STAPOS SUBGROUP                         COMMON
INFORMATION   STATION COORDINATE CARD: Coordinates for stations STAPOS
ADJUSTMENT    CORREL  : Correlation between station cooordinates STAPOS
CONTROL       FIXED   : Specify fixed stations                  STAPOS
              ADJUSTED: Adjusted stations/ Sigma for stations   STAPOS
ADJUSTMENT    CONSTADJ/                                         STAPOS
CONTROL       CONSTEND: Constrained stations control            STAPOS
              INSTRMNT: Parameters for tracking instrument      STAPOS
              GEODETIC: Overrides the Earth's parameters for    STAPOS
                        certain stations
```

```
TIDE              ETIDEN : Colombo Earth tide model using              COMMON
MODELING                   normalized Legendre polynomials.
                  ETIDES : Colombo Earth tide model using              COMMON
                           unnormalized Legengre polynomials.
                  H2LOVE : Modification/adjustment of solid Earth      COMMON
                           tide coefficient of the 2nd kind.
                  L2LOVE : Modification/adjustment of solid Earth      COMMON
                           tide coefficient of the 3rd kind.
                  TIDES  : Modifies Earth tide perturbations.          COMMON
                  OLOAD  : Applies ocean loading using the expanded    COMMON
                           poletide model.
                  OTIDEN : Ocean tides using the Colombo model         COMMON
                           with normalized Legendre polynomials.
                  OTIDES : Ocean tides using the Colombo model         COMMON
                           with unnormalized Legendre polynomials.


VARIANCE/    ADJUSTED: Adjusted stations/ Sigma for stations           STAPOS
COVARIANCE
                  NORMPV : Normal point orbit adjustment control          ARC
                           and a-priori variance input.
                  VARCOV : A-priori var/covar matrix for the             ARC
                           satellite elements.
                  SIGMA  : Observation correction editing sigma         DATA
```

2.2 GLOBAL SET MANDATORY CARDS

2.2.1 TITLE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
USER SPECIFIED JOB DESCRIPTION - CARD 1
USER SPECIFIED JOB DESCRIPTION - CARD 2
USER SPECIFIED JOB DESCRIPTION - CARD 3
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-80	10A8	User may specify on these three cards, information description of the job. These cards may also remain blank, but must always be present.	

IF CARDS OMITTED: Run will abnormally terminate.

2.3 GLOBAL SET OPTION CARDS

2.3.1   ADELAY

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ADELAY          19601101                    1.0         1.00D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

1-6     A6      ADELAY: Introduces parameters that describe
                and/or estimate  the Antenna Transponder Delay
                of a S/C or a laser bias in the case of a multi-beam altimeter

15-17   I3      Antenna number
                If on columns 16-17 the ID is a number  51-59 then this ID
                represents a laser ID and the Antenna Transopnder Delay
                will be treated a laser bias to be added to the measurement bias.

18-24   I7      Satellite ID

25-44   D20.8   A priori value of the Antenna Transponder Delay

45-59   D15.3   Sigma of the Antenna Transponder Delay

NOTE: The ADELAY card content  will be paired with the OFFSET card featuring
      the same antenna number.
EXAMPLE:
OFFSET 91       11606401                       1.430712      -5.320D-06   1.419411
OFFSET 91       21606401                       1.287648      -0.4826000   .1359708
OFFSET 91       31606401                      -1.305229      -0.6616698   2.009962
OFFSET 91       41606401                       1.417400      -0.6858000   .2482772
ADELAY          11606401            580.4808        1.00D-20
ADELAY          21606401            575.3643        1.00D-20
ADELAY          31606401            569.9368        1.00D-20
ADELAY          41606401            576.6929        1.00D-20


UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second
        H  =Hertz     ; MH =Mega-Hertz;

IF CARD OMITTED:  No antenna transponder delay will be computed
                  or estimated.
```

2.3.2 ALTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ALTIM   1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTIM - Controls various options connected with the altimetry measurement type.	
7	I1	= 0 Dynamic portion of altimetry measurement partials wrt gravity coefficients will be considerd.	0
		= 1 Dynamic portion of altimetry measurement partials wrt gravity coefficients will not be considered.	
8	I1	= 0 Geometric portion of altimetry measurement partials wrt gravity coefficients will be considered.	0
		= 1 Geometric portion of altimetry measurement partials wrt gravity coefficients will not be considered.	
9	I1	= 0 GEODYN IIE will not replace a geoid supplied from the data tape unless gravity coefficients are being adjusted.	0
		= 1 GEODYN IIE will replace a geoid supplied from the data tape (with the geoid implied by the gravity coefficients) even if gravity coefficients are not being adjusted.	
		= 2 GEODYN will use an external grid to compute the mean sea surface. This computation will replace the Geodyn computed geoid and sea surface height. The external grid file is input on unit 29 of Geodyn IIE. [NOTE 4]	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	= 0 GEODYN IIE will not replace geometric earth tides from the data tape unless H2 Love number is being adjusted. [NOTE 5]	0
		= 1 GEODYN IIE will replace geometric earth tides from the data tape even if H2 Love number is not being adjusted. [NOTE 5]	
11	I1	= 0 GEODYN IIE will not replace geometric ocean tides from the data tape. [NOTE 5]	0
		= 1 GEODYN IIE will replace geometric	

```
                    ocean tides from the data tape. [NOTE 5]

                    = 2  GEODYN IIE will compute the geometric
                    ocean tides using the GOT99.2 Ray model. [NOTE 3]

12       I1         = 0  GEODYN IIE will not replace sea surface        0
                    topography from the data tape.  [NOTE 5]

                    = 1  GEODYN IIE will replace sea surface            0
                    topography from the data tape.  [NOTE 5]

13       I1         Index to the altimetric observation modeling

                    = 0  Use the S/C normal height for modeling        0
                    the observation.

                    = 1  Use the provided external attitude             0
                    information to model the altimetric
                    observation

                    =2   External attitude information is provided
                    at observation times on the data records.
                (Ocean parameter records - words 6-9)

14       I1         Total number of points for a dynamic crossover   cols 18-19
                    stream after best time estimation

15       I1         Number of inner iterations after which the number
                    on column 14 replaces the number on columns 18-19
                    and the number on columns 20-21 replace the
                    number on columns 18-19

18-19    I2         Number of observations retained below each side
                    of a crossover (used in dynamic crossover
                    processing - mtype 101)

20-21    I2         Degree of the polynomial used for dynamic
                    crossover fitting.

22-23    I2         Second choice for degree of the polynomial for
                    dynamic crossover fitting.

25-44    D20.8      A priori value for crossover radial separator.    (0.01)

45-59    D15.3      Crossover partial editing level (cm)                10000

60-72    D13.1      Crossover distance editing level (cm)                0

73-80    D8.2       Maximum number of sltimeter bounce iterations


 NOTE [1]: It is possible to turn off either the dynamic portion of the
           Altimetry partials wrt to gravity coefficents or the geometric
           portion but not both.

 NOTE [2]: If geoid, earth tide, or ocean tide models are not supplied from
           the Altimetry data, GEODYN IIE will automatically calculate the
           models not supplied.
```

```
NOTE [3]: For the geometric ocean tide model correction using the GOT99.2
          Ray tide model the analyst needs to include the following grid
          file in the directory where Geodyn IIE is executed:

          Hp:
          /geod4/geodyn/SUPPORT/dat_raytide/got99_grid.dat
          Cray:
          /u2/z8sgp/geodyn/support/dat_raytide/got99_grid.dat

NOTE [4]: To run this option the external grid file must be ftp'd from unitree
          to the directory where Geodyn IIE is executed onto unit 29:

          Cray file:
          /u2/z8sgp/zms0l/mssdata/mssh95.one16th.deg.craybin.Z
          Hp file:
          /u2/z8sgp/zms0l/mssdata/mssh95.one16th.deg.hpbin.Z

NOTE [5]:  For a better understanding of the functions invoked by the indices
           on columns 10 and 11 see the table below:
```

Col 10 FLAGS:

GEODYN INPUT CARDS		0	1
ETIDES H2 L2	NO Sigma	1. ΔT_{SE} will be read from input tape 2. There are no dynamical direct effects	1. GEODYN will compute ΔT_{SE} using the Merit Standards for H2, L2, K1, and $\delta\Delta T$ 2. There are no dynamical direct effects
ETIDES H2 L2	WITH Sigma	1. GEODYN will compute ΔT_{SE} 2. Partials for H2 and L2 will be generated	1. GEODYN will compute ΔT_{SE} 2. Partials for H2 and L2 will be generated

Col 11 FLAGS:

GEODYN INPUT CARDS		0	1
OTIDES	NO Sigma	1. ΔT_{OC} will be read from input tape 2. ΔV will be computed from the ocean tide model	1. ΔT_{OC} comes from the OTIDE cards 2. ΔT_{OC} comes from the OTIDE cards
OTIDES	WITH Sigma	1. ΔT_{OC} will be read from input tape 2. Dynamic partials will be generated for ocean tides 3. NO geometric partials will be generated	1. ΔT_{OC} comes from the OTIDE cards 2. Dynamic partials will be generated 3. $\delta\Delta T_{\mathrm{OC}}$ will be read from the input tape

```
ΔT_SE Correction for the solid Earth tides
ΔT_OC Correction for the ocean tides
```

2.3.3 ALTIM2

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ALTIM2 100
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTIM2 - Controls various options connected with the altimetry measurement type.(CONTINUED)	
7-10	I4	Defines perturbation value used to estimate numerical partials observations wrt satellite coordinates.	100 meters
12	I1		
13	I1		
14	I1		
15	I1		
16	I1		
18-19	I2		
20-21	I2		
22-23	I2		
25-44	D20.8		
45-59	D15.3		
60-72	D13.1		
73-80	D8.2		

2.3.4 ALTOUT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ALTOUT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests creation and output of the altimetry geolocation file on unit 18.	
8	I1	=0 No output. =1 Output the geolocation file at the first inner iteration of the first global iteration. =2 Output the geolocation file at the last inner iteration of the first global iteration. NOTES [2], [3]	
9	I1	=0 No output. =1 Output the PDOUT file at the first inner iteration of the first global iteration. =2 Output the PDOUT file at the last inner iteration of the first global iteration.	
25-44	D20.8	Mission reference date	YYMMDDHHMMSS
45-59	D15.3	Mission reference fraction of seconds	0.SSSSSSSS

NOTE [1]:   The ALTOUT option applies only to altimetry or crossover data.

NOTE [2]:   If dynamic crossover data type is being processed (mtype 101) and an ALTOUT 2 card is present, a geolocation file will be output at the last inner interation.

NOTE [3]:   If Laser Altimeter modeling using external attitude is invoked and an ALTOUT 2 card is present, a geolocation file will be output at the last inner iteration.

IF CARD OMITTED: No Geolocation file will be output

2.3.5 ANTPHC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ANTPHC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ANTPHC - Requests the input of tables with phase center
                         variations (PCV) for GPS transmitter, ground
                         station and user satellite receivers. The PCV
                         corrections are input on unit 22. When this
                         option is invoked columns 9-10 of the INSTRMNT card
                         (STATION POSITION SUBGROUP) is used to identify
                         the type of antenna used at each station. For
                         satellite antennae the antenna number is obtained
                         from columns 11-12 of the OFFSET card. As many as
                         99 PCV tables can be input simultaneously on unit
                         22. The table of corrections for each antenna must
                         begin with a line that has 8 characters starting
                         in column1: ANTNO=NN where NN is an integer from
                         1 through 99. After that there must be a header
                         record. The format of header record is
                         '(I4,2F7.2,I4,2F7.2)'. These six numbers are
                         I4:   the number of zenith angles in the table
                         F7.2: the first zenith angle
                         F7.2: step of zenith angle
                         I4:   the number of azimuth angles
                         F7.2: the first azimuth angle
                         F7.2: step of azimuth angle
                         The header record must be followed by the data
                         record. The number of data must match the header
                         record (the number of zenith angles times the number
                         of azimuth angles). Each line contains 8
                         corrections (8D10.4).

15-17   I3   Measurement Type which the correction will be   0
                         applied to. (This is only necessary when using
                         the ANTPHC option for DORIS station antennae
                         phase map correction, MTYPE=40)

                         The data should be stored in the order of azimuth vs
                         zenith. For example, if there are NAZM azimuth angles
                         and NZEN zenith angles for a table. The first NAZM
                         numbers are for the first zenith angle. The (NAZM+1) to
                         2*NAZM numbers are for the second zenith angle, etc.
                         A sample table with ANTNO 28 is given below.

                         Note when ANTPHC is present and an antenna number
                         specified in either OFFSET card or INSTRMNT card
                         cannot be found from the external table file, PCV
                         corrections will no be applied for that satellite
                         or station.

                         See also INSTRMNT and OFFSET card

```
A sample PCV table:
ANTNO=28
  91    0.00    1.00    1    0.00 360.00
-.6100D-02-.5200D-02-.3300D-02-.1000D-020.1400D-020.3500D-020.4700D-020.4900D-02
0.4100D-020.2800D-020.8000D-03-.1000D-02-.2100D-02-.2100D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02
```

2.3.6 ANTPH2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ANTPH2
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ANTPH2 - Requests application of GPS antenna phase correction
                          by an external PCV file on unit 22. Multiple PCV
                          tables can be input simultaneously on unit 22. Each
                          table of corrections must start with a line beginning
                          with either STANO or SATID, followed by the station
                          number or satellite ID. (See Note 1)

                          Next, there needs to be a header record. The format
                          of header record is '(I4,2F7.2,I4,2F7.2)'.
                          These six numbers are
                          I4:   the number of zenith angles in the table
                          F7.2: the first zenith angle
                          F7.2: step of zenith angle
                          I4:   the number of azimuth angles
                          F7.2: the first azimuth angle
                          F7.2: step of azimuth angle

                          The header record must be followed by the data
                          record. The number of data must match the header
                          record (the number of zenith angles times the number
                          of azimuth angles). Each line contains 8
                          corrections (8D10.4).

                          The data should be stored in the order of azimuth vs
                          zenith. For example, if there are NAZM azimuth angles
                          and NZEN zenith angles for a table. The first NAZM
                          numbers are for the first zenith angle. The (NAZM+1) to
                          2*NAZM numbers are for the second zenith angle, etc.
                          A sample table is given below.

                          Unit 22 should be structured with the SATID tables
                          before the STANO tables, followed by the ANTNO
                          tables. With this structure, both ANTPHC and ANTPH2
                          options can be used with one external file.

NOTES:
      Note 1
          If there is more than one antenna for a station, than
          the STANO header will need an antenna number included
          following the station number. Include this antenna
          number on the INSTRMNT card. (If there is only one
          antenna, there is no need for an antenna number
          following the station number or on the INSTRMNT card.)

A sample of two PCV tables on unit 22:

```
SATID=7801041
  91    0.00    1.00    1    0.00 360.00
-.1000D-02-.2600D-02-.1200D-02-.9000D-030.5000D-030.1400D-020.2000D-020.2000D-02
0.1700D-020.5000D-03-.1000D-03-.6000D-03-.7000D-03-.6000D-03-.3000D-030.2000D-03
0.9000D-030.1800D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-02
STANO=14200501
  17    0.00    5.00    1    0.00 360.00
0.0000E+00-.9937E-03-.2876E-02-.5380E-02-.7822E-02-.1083E-01-.1299E-01-.1450E-01
-.1550E-01-.1549E-01-.1489E-01-.1354E-01-.1161E-01-.9500E-02-.6603E-02-.2883E-02
0.1401E-02
```

2.3.7 APLOAD

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+---8
APLOAD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	APLOAD - Requests application of atmospheric pressure loading on all sites featured in the IIS input APLFIL (UNIT 24)	

```
                    The information on the APLFIL may be obtained from
                    three (3) different models:
                    1. The Leonid Petrov model
                    2. The Jean Paul Boy model
                    3. The Tony Van Dam model
                    The Atmospheric Pressure Loading displacements
                    are given at 6 hour intervals and refer to the site
                    (Geodyn 4 digit site) number. This 4 digit site number is
                    the same as the site number on the OLOAD option card.
```

IF CARD OMITTED: Atmospheric Pressure Loading will not be applied.

2.3.8 ATGRAV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ATGRAV
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ATGRAV - Requests application of
                     atmospheric effect on the gravity
                     field. The presence of this card
                     requests input data on Unit 18 in
                     GEODYN IIS. [1] The data are times and
                     coefficients describing the atmospheric
                     models.

7-8   I2   Maximum degree of expansion. [2]   50

9-10   I2   Maximum order of expansion. [2]   50

11-12   I2   Indicator for linear interpolation   0

                     =0 Do not perform linear interpolation
                        for the atmospheric coefficients. Apply
                        the given values if time of observation
                        falls six hours before or after the time
                        where the coefficients were computed.
                     =1 Perform linear interpolation. Use the pair
                        of atmospheric coefficient sets that preceed
                        and follow the observation time. For
                        observations that fall before the first
                        and after the last set perform linear
                        extrapolation

13   I1   SWITCH to perform interpolation on C21
                     and S21 coefficients   0
                      = 0 do not perform interpolation
                      = 1 perform interpolation on C21 and S21

25-44   D20.8   YYMMDDHHMMSS.SS Start time of
                      application   epoch start
                                                                 time
45-59   D15.3   YYMDDHHMMSS.SS End time of
                      application   epoch stop
                                                                 time

NOTE [1]: GEODYN IIS unit 18 is a binary file which contains in each record.

          (a) The time in the middle of the time period where the
               following coefficients apply and
          (b) a stream of DEGxORD coefficients in the following sequence

               C00
               C10
               C11
               S11
               C20
               C21

```
                    S21
                    C22
                    S22
                    C30
                    C31
                    S31
                    C32
                    S32
                    C33
                    S33
```

NOTE [2] : The expansion should be less than or equal to the
             gravity field expansion. If not, only the coefficients
             of degree and order less than the maximum degree and
             order of the gravity field will contribute.
             GEODYN will accept up to 90x90 expansions for this option
             given at 3 hour intervals.

IF CARD OMITTED: Atmospheric effect will not contribute to the
                  gravity coefficients.

2.3.9 ATMDEN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ATMDEN  71
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ATMDEN - Specifies the static density
                   model that will be used for atmospheric
                   density calculations.

9-10   I2   Model selection number.   71

                     = 71 - Jacchia 1971 Model
                     = 87 - French Drag Model [1]
                     = 86 - MSIS Empirical Drag Model [2]

11-12   I2   = 0 or 1 For Mars runs, the Culp-Stewart 1983   1
                               atmospheric density model is used
                     = 2   For Mars runs, the Stewart 1987
                               atmospheric density model is used
                     = 3   For Mars runs, the Mars Global Reference
                               atmospheric density model is used
                               (Marsgram)
                     = 4   For Mars runs, the revised Stewart atmospheric
                               density model (by Lemoine) will be used
                     = 5   For Mars runs, DTM-MARS is used

                     = 0 or 1 For Venus runs, the JPL atmospheric
                               density model is used
                     = 2   For Venus runs, the Hedin atmospheric
                               density model is used

15-16   I2   Controls choice of 3 hourly or daily Kp values
                   and whether the solar flux average is for the end
                   or midpoint of the 81 day averaging interval for
                   atmospheric density model 87.

         Column 15   Controls whether the 81 day average solar flux
                     value is calculated with the moving average at
                     the end point or midpoint of the averaging
                     interval.

                       = 0 End point of interval
                       = 1 Midpoint of interval

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

         Column 16   Controls whether 3 hourly or daily values of Kp
                     are used.

                       = 0 3 hourly Kp values used   [NOTE 1]
                       = 1 Daily Kp values used

25-44   D20.8 Controls the maximum height in Venus runs with JPL

Model and Hedin Model. Range is 1.0km - 1000000.0km

45-59   D15.3 If the DTM-MARS model is selected, this   0.
               value gives the dust opacity (infrared wavelength)

NOTE [1]: Requires that 3 hourly Kp values be available in the BIH
          Tables file on UNIT02.

NOTE [2]: Works with both 3-hourly Kp values and 24-hour Kp values.

IF CARD OMITTED: The Jacchia 1971 density model will be used for
                  atmospheric density calculations.

2.3.10 BINAST

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
BINAST                                      200.            1.00    400.0     0.10
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6       BINAST - Introduces a second planetary body
                         to be integrated

25-44   D20.8    Value of GM

45-59   D15.3    Sigma for GM

60-72   D13.1    Value of semi-major axis
73-80    D8.2    Sigma for semi-major axis
```

2.3.11 CGMASS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CGMASS                                        .02            -.16         -5.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	CGMASS - Defines new mass ratio and body-centered coordinates of center of gravity with respect to center of figure.	
7-14	I8	Ratio of current spacecraft mass to value on SATPAR card in units of 1.0E-7.(DEFAULT=10000000 for a ratio of 1)	10000000
15	I1	=0 No external CGMASS coordinates will be read. =1 Read external ascii CGMASS coordinates for this satellite. =2 Read external binary CGMASS coordinates for this satellites. [NOTE 2]	0
18-24	I7	Satellite ID (required)	0
25-44	D20.8	Start Date and Time in YYMMDDHHMMSS. [NOTE 1]	0.
45-59	D15.3	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (X coordinate in meters).	0. M
60-72	D13.1	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (Y coordinate in meters).	0. M
73-80	D8.3	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (Z coordinate in meters).	0. M

NOTE 1: The time provided on the CGMASS option must be equal to or
        less than the beginning of the satellite arc. This will ensure
        that the CGMASS is applied throughout the entire arc. If there
        are multiple CGMASS cards the CGMASS will be applied until the
        next CGMASS card starts.

NOTE 2: The time dependent external CGMASS coordinates file should be
        named as cgmassXXXXXXX, where XXXXXXX is the satellite ID number.
        The data structure of cgmassXXXXXXX is as following:
        Header record: (4 real numbers)
        Satellite ID

```
        Start time in UTC YYMMDDHHMMSS.SS format
        Stop time in UTC YYMMDDHHMMSS.SS format
        Time step in seconds
        Data record:
        Time tag
        X coordinate
        Y coordinate
        Z coordinate

UNITS: KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second


IF CARD OMITTED:   The ratio of current spacecraft mass to the value on the
                   SATPAR card is 1.
```

2.3.12 COMCOF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
COMCOF
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   COMCOF - Defines and/or requests adjustments
                  of body-centered coordinates for center
                  mass- center of figure OFFSET of an orbited
                  celestial body.

25-44   D20.8   x coordinate of the com-cof offset

45-59   D15.3   y coordinate of the com-cof offset

60-72   D13.1   z coordinate of the com-cof offset

73-80   D8.3   Sigma for the com-cof coordinates

2.3.13 CYBG2E

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CYBG2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```


COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   CYBG2E - Specifies that the interface
                 file output by GEODYN IIS on unit 11
                 will be for a IIE run on a CYBER 200
                 series computer.

                 Information in the interface file
                 will be treated as follows:

                 Double precision - left as 64 bit
                 IBM words to be converted on the
                 CYBER

                 Integers - converted from 32 bit
                 IBM words to 64 bit CYBER integer
                 words

                 Logicals - converted from 32 bit
                 IBM words to 64 bit CYBER logical
                 words

                 Alpha-numeric - converted from
                 EBCDIC to ASCII

IF CARD OMITTED: Interface file will be created for the Cyber computer. See
                 IBMG2E option for outputting IBM interface file.

2.3.14 DELAY

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
DELAY
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DELAY - Defines transponder delay curve.	
7-14	I8	Station number. (This field required if Satellite ID is missing. This field is ignored if Satellite ID is present.)	0
15-17	I3	Antenna number (optional if frequency is specified)	0
18-24	I7	Satellite ID (required)	0
25-44	D20.8	Frequency in megahertz (No frequency implies all frequencies)	0. MH
45-59	D15.3	Transponder delay.	0. S
60-72	D13.1	Transponder delay rate as a function of rho dot in seconds per meter per second.	0. S/(M/S)
73-80	D8.3	Transponder delay variation as a function of rho dot squared in seconds per (meter per seconds) squared.	0. S/(M/S)**2

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
       H =Hertz   ; MH =Mega-Hertz;

IF CARD OMITTED: No antenna transponder delay will be applied.

2.3.15 EARTH

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EARTH 0        20 20          3.986004359D+14 6378144.11      298.255
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	EARTH - Modifies the earth's gravitational potential and/or introduces new earth constants.	
7	I1	Gravity model initalization indicator.	0
		= 0 Gravitational coefficients are initialized from gravity model file. They may be changed by GCOEF, GCOEFC or GCOEFS cards.	
		> 0 Gravitational coefficients are set to zero except those which appear on GCOEF, GCOEFC, or GCOEFS cards which follow this card.	
8	I1	Gravity model print control switch.	0
		= 0 Print two portions of model: 1. lowest degree & order; and 2. highest degree & order.	
		= 1 Print entire gravity model. :	
			: N/A
		= 2 Print only model checksum. :	
9	I1	Indicator of the contents of the remainder of this card:	0
		= 0 Columns 25-72 contain the values for GM, ae,1/fe.	
		= 1 Columns 25-72 contain the sigmas for GM, ae, 1/fe.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	Maximum degree of coefficient to be used in the gravitational model. Minimum =3. Default depends on gravity model file on unit 12.(See NOTES)	3
18-20	I3	Maximum order of coefficient to be used in the gravitational model. minimum =2. Default depends on gravity model file on unit 12.	2
25-44	D20.8	Universal gravitational constant	3.9860064D14 M**3/S**2

```
                    times the mass of the Earth (GMe)
                    or sigma value if column 9 =1

45-59   D15.3   Semi-major axis of the Earth (Ae) or        6378138.0          M
                sigma value if column 9 =1

60-72   D13.1   Inverse of the Earth's flattening             298.255
                (1/fe) or sigma value if column 9 =1



NOTES:
    [1]   The default values for degree and order of the gravity field and
          the Earth constants are overridden by the values from the gravity
          model file on unit 12.

    [2]   EARTH and PLANET are actually the same keyword card except that
          EARTH automatically supplies the planet number (0300) and does not
          have planetary position adjustment capability.


UNITS:   KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second


IF CARD OMITTED:   The complete geopotential field contained in
                   the default gravity model file on UNIT 12 will be used.
```

2.3.16   ELEVWT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELEVWT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                          DEFAULT VALUE & UNITS

1-6      A6       ELEVWT - Requests application of elevation
                       dependent down weighting

11-12    I2       Option Indicator [NOTE 1]                        0

                  If == 99, this card is used as a header card
                  If.NE.99, this card is used as a data card

13-14    I2       Elevation angle                                 0      Deg

                  If Option Indicator = 99
                      Maximum elevation angle at which the
                      observation weight will be decreased

                  If Option Indicator NE 99
                      Elevation angle which to apply down weighting
                      scale factor

15-17    I3       Measurement Type (required on every card)        0

25-44    D20.8    IF Option Indicator NE 99                        0.
                      Down-weighting scale factor
```

```
NOTES:
        Note 1   A set of elevation dependent down-weighting may
     be given for each measurement type. Each set of down-weighting
     scale factors must begin with a header card. Following the
     header card, the down-weighting scale factors must be given in
     descending order at one degree intervals down to zero.

IF CARD OMITTED:  Elevation dependent weighting will not be applied.

EXAMPLE: Elevation dependent downweighting for Measurement Type = 40
         for elevation angles up to 15 degrees:

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELEVWT    9915040
ELEVWT        15 40        0.99500
ELEVWT        14 40        0.99000
ELEVWT        13 40        0.98500
ELEVWT        12 40        0.98000
ELEVWT        11 40        0.97500
ELEVWT        10 40        0.97000
ELEVWT        09 40        0.96500
ELEVWT        08 40        0.96000
ELEVWT        07 40        0.95500
ELEVWT        06 40        0.95000
```

```
ELEVWT          05 40        0.94500
ELEVWT          04 40        0.94000
ELEVWT          03 40        0.93500
ELEVWT          02 40        0.93000
ELEVWT          01 40        0.92500
ELEVWT          00 40        0.92000
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```

2.3.17 EPHEM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EPHEM         200
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   EPHEM - Tells GEODYN which ephemeris
                   is being input on unit #1. This
                   card is required to select the
                   DE118 ephemeris and is optional
                   for the DE96 and DE200 ephemerides.

15-17   I3   Ephemeris indicator as follows: 200

                   = 96 - DE96 ephemeris using mean
                          equator and equinox of 1950
                          and Woolard's nutations
                          series.

                   =118 - DE118 ephemeris using mean
                          equator and equinox of 1950
                          coordinates and Wahr's
                          nutations series.

                   =200 - DE200 ephemeris using mean
                          equator and equinox of 2000
                          coordinates and Wahr series
                          nutations. The selection of
                          the DE200 ephemeris also
                          causes different precession
                          and Greenwich Mean Sidereal
                          Time(GMST) calculations.

 NOTE: GEODYN is unable to distinguish between the DE118 and DE200
        ephemerides without this option card, but it is able to distinguish
        between the DE96 and the later DE118 and DE200 ephemerides. Thus
        this card is REQUIRED only when the DE118 ephemeris is selected. For
        the DE96 and DE200 ephemeris the program will determine which
        ephemeris is actually supplied on unit #1

IF CARD OMITTED: DE200 ephemeris is assumed input on UNIT 1. If a DE96
                   ephemeris is input on UNIT 1 and this option card is
                   not present, GEODYN will reject the DE96 ephemeris and
                   function properly.

2.3.18   EPHEM2

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
EPHEM2          30
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   EPHEM2 - Introduces a supplementary
                  planetary ephemeris for use in GEODYN
                  to determine celestial body positions.
                  The supplemenatry planetary ephemeris
                  might include data from one or more
                  celestial bodies.
                  Anyone of the bodies can be used as
                  the center of integration or just for
                  force modeling purposes. [1]

8   I1   Sequence of the celestial body that
                  will be used as center of integration.
                  If this field is zero none of the
                  celestial bodies in the supplementary
                  ephemeris will be the center of integration.

15-17   I3   Number of celestial bodies in the
                  supplementary planetary ephemeris.

Note [1] : Use the global option SCBODY for the additional celestial
           bodies, physical parameter estimation and gravity field
           specification.

IF CARD OMITTED: GEODYN will not use a supplementary ephemeris.

2.3.19 ETIDEN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ETIDEN          +1101 010 -0.033              0.0              10.          10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ETIDEN - Requests application and/or adjustment of earth tides using the Colombo tide model and normalized Legendre polynomials. M and K symmetry is included.	
9	I1	Indicates form of input coefficents. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients [NOTE 1]	0
15-17	I3	Sign (+1 or -1) of the Demos Number [NOTE 2]	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0
23	I1	Indicates form of tidal amplitude coefficent [$V_f(t)$ / V_f bar] [NOTE 3] 0 = only main line, fixed coefficient 1 = main line and sidebands, variable coefficient 2 = only main line, variable coefficient	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
24	I1	Disturbing Body (B). [NOTE 2] 0 = Moon and Sun 1 = Moon 2 = Sun	0
25-44	D20.8	"A" coefficient. [NOTE 1]	0. M
45-59	D15.3	"B" coefficient. [NOTE 1]	0. M
60-72	D13.1	Sigma "A".	0. M

```
73-80   D8.2   Sigma "B".                                          0.        M
```

NOTES:

[1]   The "A" and "B" coefficients are related to amplitude and phase
        by the following formulas:

```
        A =  K2 Love Number * cos(phase)
        B = -K2 Love Number * sin(phase)
```

[2]   The "Demos Number" is given by:

```
        Demos Number = IDSIGN*(MKH*1000+(J+10)*10+B)
```

[3]   There are 4 recognized main tidal lines and 16
        associated sidebands. Their Demos numbers are:

```
                    SMKH   JB (See last page for S M K J B definitions)

Main Line 1:        1120   01
Side Bands:        -1112   01,    1100   01,    1110   01,  -1111  -21,
                    1101   21,    1111   21,    1121   21

Main Line 2:        1120   02
Side Bands:         1101   22

Main Line 3:        1220   01
Side Bands:         1201   21,    1210   01,    1211   21,    1200   01,
                   -1212   01,   -1211  -21,    1221   21

Main Line 4:        1220   02
Side Bands:         1201   22
```

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The expanded earth tide model is not used. See TIDES card for
                 tide model that will be used.

2.3.20   ETIDES

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ETIDES          +1101 010 -0.033              0.0              10.          10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ETIDES - Requests application and/or
                 adjustment of earth tides. There are   Colombo Model
              two Earth Tide models available in
                 GEODYN. First implemented was the
                 Colombo tide model and unnormalized
                 Legendre polynomials. M and K
                 symmetry is NOT included.
              The presence of a RAYTID option
              before the ETIDES cards invoques the
              IERS convention Earth Tides. Immediately
              following there is a description of the
              Colombo model. At the end of this page
              there will be a descrption of the IERS
              model.

9   I1   Indicates form of input coefficents.   0

                    0 = A and B coefficients. [NOTE 1]

10   I1   Indicates form of input sigmas.   0

                    0 = A and B coefficients [NOTE 1]

15-17   I3   Sign (+1 or -1) of the Demos Number [NOTE 2]   +1

                 This sign multiplies the quantity
                 -((2 -H) * ω + (2 - 2H + J) * M + K * Omega

18-20   I3   MKH expansion arguments of the   0
                 Demos number. [NOTE 2]
                        M = 0,1,2
                        K = 0,1,2
                        H = 0,1,2

21-22   I2   "J" expansion argument of Demos number.   0
                   -9. LE. J .LE. 9 [NOTE 2]

23   I1   Indicates form of tidal amplitude
                 coefficient [V (t) / V bar]   [NOTE 3]   0
                               f   f

                  0 = only main line, fixed coefficient
                  1 = main line and sidebands, variable
                      coefficient
                  2 = only main line, variable coefficient

24   I1   Disturbing Body (B). [NOTE 2]   0

                  0 = Moon and Sun
```

```
                    1 = Moon
                    2 = Sun

25-44   D20.8   "A" coefficient. [NOTE 1]                              0.        M

45-59   D15.3   "B" coefficient. [NOTE 1]                              0.        M

60-72   D13.1   Sigma "A".                                            0.        M

73-80   D8.2    Sigma "B".                                            0.        M



NOTES:

  [1]    The "A" and "B" coefficients are related to amplitude and phase
         by the following formulas:

             A =  K2 Love Number * cos(phase)
             B = -K2 Love Number * sin(phase)


  [2]    The "Demos Number" is given by:

             Demos Number = IDSIGN*(MKH*1000+(J+10)*10+B)

  [3]    There are 4 recognized main tidal lines and 16
         associated sidebands.  Their Demos numbers are:

                  SMKH   JB (See last page for S M K H J B definitions)

Main Line 1:       1120   01
Side Bands:       -1112   01,    1100   01,    1110   01,  -1111  -21,
                   1101   21,    1111   21,    1121   21

Main Line 2:       1120   02
Side Bands:        1101   22

Main Line 3:       1220   01
Side Bands:        1201   21,    1210   01,    1211   21,    1200   01,
                  -1212   01,   -1211  -21,    1221   21

Main Line 4:       1220   02
Side Bands:        1201   22
```

IERS EARTH TIDE MODEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ETIDES
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT      DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6      ETIDES - Requests application and/or
                adjustment of IERS convention earth tides .

9       I1      Forcing degree in tide operating potential
                (2 or 3). The order is the first integer in
                the Doodson number given in columns 18-24.
```

```
10        I1      Inteder number [0,...,3] gives phase increment
                  after x{pi/2}. Useful when all tides use cosine
              factors with positive amplitudes.


15-17     I3      Integer Flag:

            =0 no sidelines
            =1 turn n sidelines with input
               tidal constituent.
                    =2 turn n sidelines with input
               tidal group.

18-24     I7      Doodson Number (six positive integers)

25-44     D20.8   "A" coefficient.                                0.    M

45-59     D15.3   "B" coefficient.                                0.    M

60-72     D13.1   Sigma "A".                                      0.    M

73-80     D8.2    Sigma "B".                                      0.    M

Suggested setup for Earth Tides

UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds



IF CARD OMITTED: The expanded earth tide model is not used. See TIDES card for
                 tide model that will be used.
```

2.3.21 FANTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FANTIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTIM - Used for time dependent PHANTOM parameters (option FANTOM)	
7	I1	Index specifying the nature of the introduced global parameters: = 1 Geometric model global parameters = 2 Force model global parameters	
25-44	D20.8	Epoch time for a time dependent model [NOTE 1]	YYMMDDHHMMSS.
45-59	D15.3	Start time for a time dependent option. The end times are specified on the FANTOM cards.	YYMMDDHHMMSS.
60-72	D13.1	Space for real information applicable to all the parameters in the group.	
73-80	D8.2	Space for real information applicable to all the parameters in the group	

  NOTES:

    [1] This time will be considered to be a reference time with respect to
        which linear rates or periodic terms are evaluated.

    [2] Only one FANTIM card per FANTOM parameter group is allowed.

IF CARD OMITTED: And times are included on the FANTOM cards, the run will
abnormally terminate.

2.3.22 FANTOM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FANTOM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTOM - Introduces the application and/or estimation of a group of global parameters [NOTE 3]	
7	I1	Index specifying the nature of the introduced global parameters:	

                      = 1 Geometric model global parameters
                      = 2 Force model global parameters

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
8	I1	Index specifying a specific direction for the parameter appearing on cols 25-44 [NOTE 1]	

                      = 0 All the parameters in the group are
                        treated the same way (same partial formulation)

                      = 1 |
                      = 2 | To be specified by the user
                      = 3 |

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9	I1	Index specifying the nature of the contents on cols 60-72 and 73-80	

                      = 0 These real fields are not used for
the group of parametrs introduced. (Space will not be allocated for them in GEODYN).
= 1 These real fields are used as they are described below
= 2 These real fields may be used to include any type of real information (but time)

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	I7	Satellite ID	
25-44	D20.8	Parameter value	
45-59	D15.3	Parameter sigma	
60-72	D13.1	End time for application for this parameter. YYMMDDHHMMSS. (if the index on col 9 is 1) [NOTE 2]	
73-80	D8.2	Available space for extra real information.	

NOTES:

    [1] Specify up to three (3) dimensions. Although this option is not
        required in order to solve for parameters in a 3-D space or solve
        for parameters of different significance (C and S coefficients for

example) it is helpful for EMATS and other types of labeling. Also parameters with the same index will be grouped together, facilitating that way the formation of partials.

[2] Requires the presence of the FANTIM option.

[3] This option provides the necessary allocation and links for parameterizaton. In order to use this option, the user must contact a GEODYN programmer for further additions of modeling and partials code.

IF CARD OMITTED: No extra model or parameters will be included in the GEODYN calculations

2.3.23 FLUX

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FLUX  1 0
FLUX    1                       1372.5398
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUES & UNIT
1-6	A6	FLUX - Adds and/or modifies FLUX (Solar and Magnetic) values in built-in tables.	
7	I1	Table printout control for flux, polar motion, A.1-UTC, and A.1-UT1 data	0
		= 0 Table values for 36 days will be printed.	
		= 1 All Table values used for this run will be printed.	
8	I1	Flux Kp indicator.	0
		= 0 FLUX Kp values will be obtained from columns 73-80 of this card.	
		= 1 FLUX Kp values will be calculated from Ap values.[NOTE 1]	
9	I1	Flux card indicator	0
		= 0 FLUX card used to modify flux values in built-in tables	
		= 1 FLUX card specifies solar flux at 1 AU, in the real field 25-44 [NOTE 2]	
25-44	D20.8	Date of FLUX values (in form YYMMDD). (Col. 9 = 0)	0.
		Solar flux at 1AU (Col. 9 = 1)	1372.5398 10^{-22} W/M**2

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	Value of SOLAR FLUX (F10.7 at 1 A.U). If blank, value in table will not be altered. [NOTE 3]	0. 10^{-22} W/M**2
60-72	D13.1	Uses input value for average solar flux, if left blank, average will not be altered.	0. 10^{-22} W/M**2
73-80	D8.2	Value of magnetic flux Kp. If	

column 8 contains a 1 this input
                    value is
                    _   Kpi
                    Kp= log[(sum (e   ) for i=1,8) / 8]

                    where Kpi are the three-hourly
                    values of Kp.

    NOTES:

            When dates that are beyond the end of the flux tables are requested
            the average value of the last month is used. This is true for both
            solar and magnetic flux.
            Solar and magnetic flux override requests are applied to the day
            specified in columns 25-44 only.

    [1]   Kp values will be obtained by cubic interpolation of the following
            table

            Kp   Ap   Kp   Ap   Kp   Ap   Kp   Ap

            0.   0   2.3333   9   4.6666   39   7.0000   132
            0.3333   2   2.6666   12   5.0000   48   7.3333   154
            0.6666   3   3.0000   15   5.3333   56   7.6666   179
            1.0000   4   3.3333   18   5.6666   67   8.0000   207
            1.3333   5   3.6666   22   6.0000   80   8.3333   236
            1.6666   6   4.0000   27   6.3333   94   8.6666   300

            REFERENCE: "Geomagnetic Indices," by Gordon Rostoker, Reviews of
                       Geophysics and Space Physics, Vol. 10, No. 4, November 1972.

    [2]   This card can be used with or without the first flux card
            (i.e. col 9 = 0) If column 9 does not equal one, field one
            WILL NOT represent the solar flux at 1 AU. When col 9=1 this
            card CAN ONLY be used to specify the solar flux at 1 AU. A
            second card must be used to specify additional options.

            The solar flux at 1 AU is divided by the speed of light to
            compute the solar radiation pressure on the satellite.
            Therefore, when specifying this value, one must insure that
            the speed of light is consistent.

    [3]   The solar flux values input to GEODYN are the 1 A.U. values. GEODYN
            will scale the solar flux values to the actual earth-sun distance.
            The values printed out by GEODYN IIS are the scaled values.

    [4]   Both FLUX Cards are accepted in the same run.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
UNITS: DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
UNITS: H =Hertz   ; MH =Mega-Hertz; W =Watts

IF FIRST CARD OMITTED: Values from tables file on UNIT 2 will be used.
IF SECOND CARD OMITTED: Default value of solar flux at 1 AU will be used.

2.3.24 FREEZE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FREEZE
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

 1-6   A6   FREEZE: Allows the user to
                          control observation editing
                          and arc parameter contribution
                          during various iteration

 7-8   I2   Arc iteration after which the   999
                          editing of observations will
                          freeze.

 9-10   I2   Global iteration for which the   1
                          option on columns 7-8 will apply

11-12   I2   Arc iteration before which the   0
                          arc parameters will not contribute
                          to the normal matrix. This option
                          is usefulfor dynamic crossover
                          processing where a number of inner
                          iterations is needed for the best
                          crossover location extimate

IF CARD OMITTED: There will not be any editing freeze nor
                  normal matrix changes.

NOTE: A blank FREEZE card will not cause editing freeze
       nor normal matrix changes.

2.3.25 G2COFC

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+---8
G2COFC          1   0      0.144337567303D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                       DEFAULT VALUE & UNITS

1-6     A6      G2COFC -  C coefficients of the second asteroid in a binary
                          asteroid situation.

25-44   D20.8   Value of the C coefficient

60-72   D13.1   Sigma of the C coefficient


Example of G2COFC (and G2COFS cards:
G2COFC          001000
G2COFC          001001
G2COFC          002000           -.14369265D-01                .001
G2COFC          002001                                         .001
G2COFC          002002            .47033751D-02                .001
G2COFS          001001
G2COFS          002001                                         .001
G2COFS          002002                                         .001
```

2.3.26 G2COFS

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
G2COFS          1  1      0.144337567303D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

1-6     A6      G2COFS -  S coefficients of the second asteroid in a binary
                          asteroid situation.

25-44   D20.8   Value of the S coefficient

60-72   D13.1   Sigma of the S coefficient


Example of G2COFC (and G2COFS cards:
G2COFC          001000
G2COFC          001001
G2COFC          002000          -.14369265D-01                    .001
G2COFC          002001                                            .001
G2COFC          002002           .47033751D-02                    .001
G2COFS          001001
G2COFS          002001                                            .001
G2COFS          002002                                            .001
```

2.3.27 G2BOUT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
G2BOUT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUES & UNIT

1-6   A6   G2BOUT - Requests the output of a GEODYN II
                  observation file on unit 20. This option is
                  useful for GPS runs, in combination with
                  the ELCUTOFF and the SATCUT input options.
                  In these cases, GEODYN will output only
                  observations which are not edited by the
                  ELCUTOF and the SATCUT specifications.

                  Another useful application is the
                  combination G2BOUT and the TRPOUT option.

2.3.28 GCMMOD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GCMMOD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6      GCMMOD - Requests application of the periodic
                         Earth center of mass correction model.
                         The model is used to modify the position
                         of tracking stations. Multiple periodic
                         terms may be used. [NOTE 1]

  8     I2      Option Indicator                                 0


                For Option Indicator = 1

25-44   D20.8   Refrence Year                                    0.
45-59   D20.8   Period                                           0.   yr


                For Option Indicator = 2

25-44   D20.8   Amplitude of X component of correction          0.   mm
45-59   D20.8   Phase of X component of correction              0.   deg


                For Option Indicator = 3

25-44   D20.8   Amplitude of Y component of correction          0.   mm
45-59   D20.8   Phase of Y component of correction              0.   deg


                For Option Indicator = 4

25-44   D20.8   Amplitude of Z component of correction          0.   mm
45-59   D20.8   Phase of Z component of correction              0.   deg


NOTES:


        1)  Multiple periodic terms may be used to model the center
            of mass. The group of 4 GCMMOD cards must be included
            for each term. All terms must use the same reference year.

            Each component of the model is calculated as follows:

    signal = amplitude * cos( (time - reference year)*(2pi/period)- Phase )



IF CARD OMITTED:  Earth center of mass model will not be applied

EXAMPLE: The example below gives a annual periodic term
```

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
GCMMOD 1                  1950.0                  1.0
GCMMOD 2                     2.7                 41.0
GCMMOD 3                     2.8                321.0
GCMMOD 4                     5.5                 27.0
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
```

2.3.29   GCOEF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GCOEF 2       2 1                                          1.0000000D-091.00D-09
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	GCOEF - Modifies and/or requests the estimation of coefficients in the geopotential model.	
7	I1	Normalization indicator.	0
		= 0 values unnormalized C,S [See NOTES]	
		= 1 values normalized C,S	
		= 2 values ignored C,S	
15-17	I3	Degree of C and S coefficients (N index). [NOTE 1]	0
18-20	I3	Order of C and S coefficients (M index). [NOTE 1]	0
25-44	D20.8	A priori (or starting) value of C coefficient. [NOTE 2]	0.
45-59	D15.3	A priori (or starting) value of S coefficient. [NOTE 2]	0.
60-72	D13.1	Standard deviation or fractional uncertainty of C coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation. If the value is greater than 1.0D-5 (or (SQRT(1.0D-5) for J2) it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.
73-80	D8.2	Standard deviation or fractional uncertainty of S coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation If the value is greater than 1.0D-5 it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value	0.

of the coefficient. [NOTE 1]

NOTES:

[1]   The denormalization subprogram in GEODYN underflows at degree
        49 and order 48.

        The geopotential coefficient denormalization equation used is:

        $$C_n^m = \bar{C}_n^m \times D_n^m$$
        $$S_n^m = \bar{S}_n^m \times D_n^m$$

        where

        $$D_n^m = \sqrt{(4n+2)\frac{(n-m)!}{(n+m)!}} \text{ for } m > 0$$
        $$D_n^m = \sqrt{2n+1} \text{ for } m = 0$$

        and
        C_n^m, S_n^m are un-normalized coefficients.
        $\bar{C}_n^m$, $\bar{S}_n^m$ are normalized coefficients.

[2]   If the degree and/or order on the GCOEF card is greater than the
        DEFAULT values [in the gravity file on unit 12], then the highest
        degree and/or order that is specified on the GCOEF card must be
        input on the EARTH card.

[3]   If it is desired that the starting values of geopotential coefficients
        be different than the a priori values for those coefficients then the
        GCOEF card should be used as follows:

        o   GCOEF cards requesting the desired coefficient adjustments
              should be included in the setup deck. The a priori values
              will be indicated on these cards.

        o   For each coefficient pair for which the starting value is to
              be different than the a priori value, an additional GCOEF
              card should be in the setup deck. This GCOEF card will
              indicate the starting value and come later in the deck than
              the corresponding GCOEF card requesting adjustment.

[4]   Nominal values of geopotential coefficients are

        $$J_n^m = \frac{10^{-5} D_m^n}{n^2}$$

IF CARD OMITTED: The geopotential used will be from the gravity model
                   input on UNIT 12 of GEODYN-IIS unless modified by EARTH,
                   GCOEFC, or GCOEFS cards.

2.3.30   GCOEFC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GCOEFC1      002000         -.48416600D-03             .000000001
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUES & UNIT
1-6	A6	GCOEFC - Modifies and/or requests the estimation of C coefficients in the geopotential model.	
7	I1	Normalization indicator.[NOTE 1] = 0 values unnormalized = 1 values normalized = 2 values ignored	0
15-17	I3	Degree of C coefficient (n index).	0.
18-20	I3	Order of C coefficient (m index).	0.
25-44	D20.8	A priori (or starting) value of C coefficient.	0.
60-72	D13.1	Standard deviation or fractional uncertainty of C coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation. If the value is greater than 1.0D-5 (or (SQRT(1.0D-5) for J2) it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.

NOTES:
 [1]   See GCOEF card for discussion of denormalization and nominal values.

IF CARD OMITTED: The geopotential used will be from the gravity model
                  input on UNIT 12 of GEODYN-IIS unless modified by EARTH,
                  GCOEF, or GCOEFS cards.

2.3.31 GCOEFS

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
GCOEFS
---+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GCOEFS - Modifies and/or requests the estimation of S coefficients in the geopotential model.	
7	I1	Normalization indicator. [NOTE 1] = 0 values unnormalized = 1 values normalized = 2 values ignored	0
15-17	I3	Degree of S coefficient (n index).	0
18-20	I3	Order of S coefficient (m index).	0
25-44	D20.8	A priori (or starting) value of S coefficient.	0.
60-72	D13.1	Standard deviation or fractional uncertainty of S coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation If the value is greater than 1.0D-5 it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.

NOTES:
 [1]   See GCOEF card for discussion of denormalization and nominal values

IF CARD OMITTED: The geopotential used will be from the gravity model
                  input on UNIT 12 of GEODYN-IIS unless modified by EARTH,
                  GCOEF, or GCOEFC cards.

2.3.32   GCOFCT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GCOFCT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6            GCOFCT - Requests application or
                      adjustment of the C gravity
                      coefficient for the time period
                      defined below.

25-44   D20.8         Begin time of time period gravity

45-59   D15.3         End time of time period gravity

NOTE [1]: Time period gravity is introduced by groups of input cards
          where one group contains information about one discrete
          period of time. Therefore one needs as many groups as the
          number of discrete times where gravity coefficients are
          being replaced or adjusted.  These groups follow the stream
          of the original gravity field coefficients and they have the
          following structure:

          GCOFCT or GCOFST including beginning and end of time period,
          GCOEFC or GCOEFS respectively (as many as desired) with
          information about replacing value or adjustment and,
          GTPEND denoting the end of information for this time period.

          EXAMPLE:

GCOFCT                          800801000000.00800801060000.00
GCOEFC1          2  0    -.50000000000000D-03                  1.0
GCOEFC1          3  1    0.30000000000000D-05                  1.0
GCOEFC1          4  1    -.60000000000000D-06                  1.0
GTPEND
GCOFCT                          800801070000.00800801090000.00
GCOEFC1          2  0    -.50000000000000D-03                  0.0
GCOEFC1          3  1    0.30000000000000D-05                  0.0
GCOEFC1          4  1    -.60000000000000D-06                  1.0
GTPEND
GCOFST                          800801000000.00800801060000.00
GCOEFS1          3  1    0.25000000000000D-06                  0.0
GCOEFS1          4  1    -.55000000000000D-06                  1.0

IF CARD OMITTED: Time period gravity will not be applied.
```

2.3.33 GCOFST

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
GCOFST
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

1-6     A6              GCOFST - Requests application or
                        adjustment of the S gravity coefficient
                        for the time period defined below.

25-44   D20.8           Begin time of time period gravity

45-59   D15.3           End time of time period gravity



NOTE [1]: See note on GCOFCT card.


IF CARD OMITTED: Time period gravity will not be applied.
```

2.3.34   GDYNEP

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GDYNEP
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GDYNEP - specifies a new Geodyn Internal Reference Time for this run.	
25-44	D20.8	New Geodyn Internal Reference Time in "YYMMDD". [NOTE 1]	410101 (JD = 2430000.5)

```
NOTE [1]:  If YY = [51-99] the year is 19YY
           If YY = [00-50] the year is 20YY
```

IF CARD OMITTED: Geodyn will use its default reference time

2.3.35 GEOPOL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GEOPOL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GEOPOL - The GEOPOL option changes the
                 Z axis used by GEODYN for computing
                     latitude and longitude when evaluating
                 spherical harmonic functions for gravity.
                     By default (without the GEOPOL card)
                     the Z axis used by GEODYN for these
                 computations is the Earth's rotation
                     pole. However, when the GEOPOL option is
                 selected, the Z axis used by GEODYN for
                     these computations is the mean pole implied
                     by polar motion series input on unit 2.

                     Note that in either case (GEOPOL selected
                 or not), the Z axis used by GEODYN for
                     gravity computations will not be the same
                     as the Earth's figure axis. This can only
                 be compensated by the use degree 2 order 1
                     terms in the gravity field which vary
                     according to polar motion. The POLDYN and
                 POLKF option cards can be used to model
                     can be used to model these degree 2 order 1 terms.
                                                            Most users select the GEOPOL option
                     if the the GEOPOL option is selected, then it is
                     especially important to make use of the POLDYN
                     and POLKF cards. That is because the Z axis
                 implied by the GEOPOL option is further away
                     from the figure axis than the default Z axis.
                     Also note that when the GEOPOL and POLDYN
                     options are used, the user should place
                 background degree 2 order 1 terms in the gravity
                     field (see POLDYN card).

7   I1   If GEOPOL is used with the POLKF card,   0.
                 Kf is normally +1/3. So if the GEOPOL
                 card is present, the program only allows
                 positive Kf, unless a "1" is input in
                 col 7 of the GEOPOL card.
                 If = 1, can have Kf < 0.
                 If not = 1, can only have Kf > 0.

IF CARD OMITTED: See above first paragraph.
```

2.3.36   GLBARC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GLBARC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS   FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GLBARC - Requests user selected arc
                    parameter partials to be summed into the
                    E-MATRIX at the end of the arc section.
                    This allows the specified arc parameters to
                    be treated as the first global paramters in
                    the E-MATRIX. At present only the drag
                    parameters can be selected.[1]

 7   I1   Selects drag parameters   0

                     = 0 - drag parameters will be selected

                     = 1 - turns off this option for the drag parameters

8-15   Additional parameters to be added in the future.

NOTE [1]: This option only applies to E-MATRIX runs.
          The parameter is given a new E-MATRIX number. See
          Volume 5 for a description of the new E-MATRIX labels.
          labels.

IF CARD OMITTED: This option will not be enabled
                  For interplanetary runs this option will be enabled.

2.3.37 GMSUN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GMSUN                   2.11060885327268D-07          1.D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6      GMSUN  - Introduces GM of the SUN as a parameter

25-44   D20.8   GM of the sun value

45-59   D15.3   Sigma for GM
```

2.3.38 GPSMOD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GPSMOD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GPSMOD - A blank GPSMOD card should be
                            included in all GPS runs.

  7   I1   Index to allow final arc adjustment during   0
                            an EMAT/GPS run. The index must be >0 to allow
                    the arc inversion. The default (0) means thet
                    the job will terminate right after the E-MATRIX
                    was formed and saved.

  8   I1   =1   This is a gps run (measurement type 85 or 87)   0
                    but the biases are provided on the setup as
                    a combination of measurement type 41 and 43 for
                    input MTYPE=85 or a combination of measurement
                    type 41 for input MTYPE=87. Instead of providing
                    an MBIAS for the 4-legged measurement type, we
                    provide a bias for each leg (station-satellite or
                    satellite-satellite). The one way biases describe
                    horizon-to-horizon biases therefore they may apply
                    to more than one configuration.
                        =0   Input MTYPE is the same as MBIAS type for GPS
                    observations

2.3.39 GPSSHD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GPSSHD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GPSSHD - This option will instruct GEODYN to produce yaw polynomial input for GPS runs if this is not available. The computation are being done in GEODYN according to the Journal of Geodesy Paper by Bar-Sever.	
		The GPSSHD option will turn any GPS data reduction run into an ORBGEN run automatically, regardless of what other cards are present.	
		Yaw polynomials will be computed and output on unit 48 of GEODYN IIE, in the form of YAWPOL group cards. These YAWPOL group cards may be then included in the global part of the setup for data reduction with the appropriate yaw modeling. NOTE [1]	
25-44	D20.5	12 hrs + endarc time	YYMMDDHHMMSS
45-59	D15.3	Cutoff angle that helps save some computation NOTE [2]	deg 20

NOTE [1]: The end of the GPSSHD group is denoted by the presence
          of the SHDEND card. In between the GPSSHD and the SHDEND
          option cards we enter the required YAWRAT cards with yaw
          rate and yaw rate rate information.

NOTE [2]: GPS satellites are not completely shadowed, unless the beta
          angle of the orbit plane is about 15o (in absolute value)
          or less. In a GPSSHD run, GEODYN will compute the beta angle
          for each GPS satellite at EPOCH. If the absolute of the
          beta angle is greater than the cutoff (20o or the input
          on columns 45-59), for a particular GPS satellite at epoch,
          then that satellite will be excluded from all further
          consideration in the GPSSHD run.

2.3.40   GRIDS

2.3.40.1 GRIDS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GRIDS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GRIDS - Introduces the use of grid
                 elevation input files in IIE. These
                 grid data files may be mean sea surface
                 heights or land elevations from a given
                 surface or origin. The names and the
                 data for these grid files are provided
                 on the following option cards. The GRIDS
                 option ends with the ENDGRD option card.
                 No more than 6 different grids are allowed
                 as input. The grid files should be binary
                 files consisting of variable length records.
                 Each record contains REAL*4 numbers
                 representing the specified height, for all
                 the grid points of the same latitude in
                 an eastward direction. The first record
                 begins at the highest latitude, so the first
                 point in the file is located at the NW corner
                 of the grid.

IF CARD OMITTED: yet GFILE cards are present, the IIS run will abnormally
                 terminate

2.3.40.2 GFILE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GFILE   5760 82-80  0360 225.00                 225.00
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GFILE - Supplies the name and input
                          data for the grid file.

7   I1   Index for grid data origin:

                =0 Elevations are given from the reference   0
                   ellipsoid.
                =1 Elevations are given from the mean sea
                   surface
                =2 Radii are given from the center of
                   the planet
8   I1   Indicator of the data location on
                 the grid file:

                = 0   The data are located on the grid
                      intersection
                = 1   The data are located at the center
                      of the grid.

 9-12   I4   Number of data points in one record   no default

15-17   I3   Grid size   (arcsec) No default

25-44   D20.8   Maximum latitude of the grid   (deg) 90

45-59   D15.3   Minimum latitude of thr grid   (deg) -90

60-72   D13.1   Maximum longitude of the grid
                counting from 0-360 degrees.   (deg) 360

22-24   D8.3   Minimum longitude of the grid

IF CARD OMITTED: This model will not be used to compute the observations.

UNITS: M =Meters   ; S =Seconds   ; deg =Degrees

2.3.40.3 ENDGRD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDGRD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDGRD - Denotes the end of the grid file sub-group.	

IF CARD OMITTED: And GRIDS cards are present, the IIS run will abnormally
                 terminate

2.3.41   GRVEPO

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
GRVEPO                   890101000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   GRVEPO - Sets the epoch time for the
                  time dependent gravity option. See option
                  GRVTIM for more details.

25-44   D20.8   Epoch time in YYMMDDHHMMSS. for the time   0.
                  dependent gravity model. Linear rates and
                  periodic terms in the time dependent gravity
                  model will be calculated from this time.

NOTES: See option GRVTIM for the time dependent gravity formulation.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        MAS=Milliarc seconds

IF CARD OMITTED: Epoch time for time dependent gravity will be zero.

2.3.42 GRVTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GRVTIM1                                    -2.5D-11
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GRVTIM - Requests application and/or adjustment of time dependent gravity coefficients. The geopotential coefficients may be given a linear rate and/or up to nine periodic terms. The epoch time for this option is set with the GRVEPO option.	
7	I1	C or S geopotential coefficient designator. =1 C coefficient indicator. =2 S coefficient indicator.	
8	I1	Defines the content of the fields in columns 25-80 as follows:	

	Columns 25 - 44	Columns 45 - 59	Columns 60 - 72	Columns 73 - 80	
=1	Linear Rate	Rate sigma			[NOTE 2]
=2		A	B	Period	
=3		A sigma	B sigma		

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	Degree of C and S coefficients (n index)	0
18-20	I3	Order of C and S coefficients (m index)	0
21-22	I2	# of period for this coefficient (a number between 1-9)	1
25-44	D20.8	This field contains geopotential linear rate or rate sigma information as defined by the values selected in columns 7 & 8. col 8=1 Cdot or Sdot (linear rate).	per year

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	This field contains geopotential rate sigma, amplitude (A), or amplitude (A) sigma information as defined by the values selected in columns 7 & 8. col 8=1 Standard deviation for Cdot or Sdot. A non zero sigma indicates that this parameter will be adjusted. col 8=2 Amplitude (A) of cosine term. col 8=3 Standard deviation for amplitude (A). A non zero sigma indicates that this parameter will be adjusted.	

```
60-72    D13.1   This field contains geopotential amplitude
                 (B), or amplitude (B) sigma information as
                 defined by the values selected in columns
                 7 & 8.

                 col 8=2    Amplitude (B) of sine term.
                 col 8=3    Standard deviation for amplitude
                            (B). A non zero sigma indicates
                            that this parameter will be adjusted.


73-80    D8.3    This field contains the period for the
                 periodic option. The frequency will be              years
                 computed as frequency=2*pi/period.


NOTE 1:   See next page for the time dependent gravity formulation.
          The cards specifying the apriori periodic terms MUST precede the
          cards which carry the accompanying sigma information, as in
          the following example. In the following example the coefficient
          C21 has two periodic terms.

GRVTIM12            2   0                          0.0            0.0      1.0
GRVTIM13            2   0                       1.0D-07         1.D-07
GRVTIM12            2   1 1                        0.0            0.0      1.0
GRVTIM13            2   1 1                     1.0D-07         1.D-07
GRVTIM12            2   1 2                        0.0            0.0      1.0
GRVTIM13            2   1 2                     1.0D-07         1.D-07
GRVTIM12            2   2                          0.0            0.0      1.0
GRVTIM13            2   2                       1.0D-07         1.D-07
GRVTIM22            2   2                          0.0            0.0      1.0
GRVTIM23            2   2                       1.0D-07         1.D-07

NOTE 2:   Coefficient rates should be normalized in case of application
          of time dependent gravity.


IF CARD OMITTED:   Time dependent gravity will not be applied.


    The formulation for the time dependent gravity implementation follows:

1#1
+ Cdot(n,m)*(t-t0) + 2#2*(t-t0))
      + 3#3*(t-t0))


4#4
+ Sdot(n,m)*(t-t0) + 5#5*(t-t0))
      + 6#6
*(t-t0))


7#7
- Normalized geopotential C and S coefficients.
```

Cdot , Sdot   -   Linear rates for the geopotential coefficients.

t0   -   Start time for application of time dependent gravity.
                    (See GRVEPO option for setting the start time.)

t   -   Current time. Time at which time dependent gravity

will be computed.

Aci ,Asi   -   Amplitude of the cosine term for the C or S coefficient

for application of a periodic gravity effect.

 Bic ,Bsi   -   Amplitude of the sine term for the C or Scoefficient

for application of a periodic gravity effect.

Omegai(n,m)   -   Frequency for the periodic gravity effect for the
                    (n,m) coefficients. (Where Frequency=2*pi/period)

8#8

2.3.43   GTPEND

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+----8
GTPEND
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                      DEFAULT VALUE & UNITS

1-6     A6             GTPEND - Requests end of application
                       of time period gravity



IF CARD OMITTED:  Abnormal termination will occur.
```

2.3.44 GXPAND

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+---8
GXPAND    02 36 01                                              1.0D-06  1.0D-06
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GXPAND - Requests estimation of a range of geopotential coefficients.	
11-14	I4	Starting degree for geopotential estimation.	2
15-17	I3	Ending degree for geopotential estimation. (Default = degree of geopotential specified on EARTH card.)	0
18-20	I3	Starting order for geopotential estimation.	0
21-24	I4	Ending order for geopotential estimation. (Default = degree of geopotential being generated.)	0
60-72	D13.1	Standard deviation of C coefficient. [NOTE 1]	0.
73-80	D8.2	Standard deviation of S coefficient. [NOTE 1]	0.

NOTES:

      The a priori values of the coefficients will be obtained from the current geopotential model including all modifications to the model prior to this card.

 [1]   See GCOEF card for explanation of the standard deviation for the C and S coefficients.

IF CARD OMITTED: Geopotential coefficients will not be requested unless requested by GCOEF, GCOEFC, or GCOEFS cards.

2.3.45 H2LOVE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
H2LOVE                   .600
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   H2LOVE - Requests that solid earth
                 tide coefficients of the second
                 kind be modified and/or adjusted.

7   I1   If > 0, print solid tide correction
                 to station height. [NOTE 1]

25-44   D20.8   A priori value of love number of   .600
                 the second kind to account for
                 radial displacement, H2.

45-59   D15.3   A priori sigma of H2. If greater   0.
                 than 0, requests adjustment of H2.

                                 NOTE [1]: Solid tide induced changes in station h
          unit 98.

IF CARD OMITTED: Default value (H2 = 0.600) will be used.
```

## 2.3.46  I32G2E

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
I32G2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	I32G2E - Specifies options for the interface and data file output by GEODYN IIS on unit 11 and 41 for a 32 bit integer machine.	
8	I1	Specifies whether binary or formatted interface and data files will be created by IIS.	0

               =0 Binary interface and data files
                    will by created with the following
                    attributes:

               Information in the interface file
               will be treated as follows:

DESCRIPTION	DEFAULT VALUE & UNITS
Floating point - 64-bit IBM word.	64-bit IBM word.
Integers - IBM 32-bit word.	null 32-bit IBM word and 32-bit IBM word.
Logicals - IBM 32-bit word.	null 32-bit IBM word and 32-bit IBM word.
Alpha-numeric - EBCDIC characters.	EBCDIC characters.

               =1 formatted interface and data
                    file wil be created.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Specifies 80 column or 132 column formatted interface and data files.	0

               =0 132 column formatted interface
                    and data files will be created.

               =8 80 column formatted interface
                    and data files wil be created.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
11-17	l7	Core memory requested for IIS in MW.	2.4 MW

 IF CARD OMITTED: Binary Interface and Data files will be created for
                   a 64 bit integer machine.

2.3.47   I64G2E

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
I64G2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	I64G2E - Specifies options for the interface and data file output by GEODYN IIS on unit 11 and 41 for a 64 bit integer machine.	
8	I1	Specifies whether binary or formatted interface and data files will be created by IIS.	0

=0   Binary interface and data files
     will be created with the following
     attributes:

  Information in the interface file
  will be treated as follows:

  Double precision - left as 64 bit
  IBM words to be converted on the
  CYBER

  Integers - converted from 32 bit
  IBM words to 64 bit CYBER integer
  words

  Logicals - converted from 32 bit
  IBM words to 64 bit CYBER logical
  words

  Alpha-numeric - converted from
  EBCDIC to ASCII

=1   formatted interface and data file
     will be created.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Specifies 80 column or 132 column formatted interface and data files.	0

=0   132 column formatted interface and
     and data files will be created.

=8   80 column formatted interface and
     data files will be created.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
11-17	l7	Core memory requested for IIS in MW.	2.4 MW

IF CARD OMITTED: Binary Interface and data files will be created for a

64 bit integer machine. See I32G2E option for outputting
an interface and data file for a 32 bit integer machine.

2.3.48 IAU200

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
IAU200
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	IAU200 - If this card is present GEODYN will use the new IAU-2000 standards for precession and nutation. New precession modules will be called in GEODYN IIE and the Chebyshev polymomial coefficients to produce the nutations DPSI and DEPS will be read from a special planetary ephemeris. The presence of the IAU200 option requires that presence of the new planetary ephemeris on input unit 1 of GEODYN IIS. and vice versa. If only one of the above conditions does not exist, GEODYN will terminate abnormally.	

IF CARD OMITTED: GEODYN will aplly the old precession and nutation standards.

2.3.49   INTGCB

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
INTGCB
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	INTGCB- In interplanetary mode this option allows the dual orbit determination of a satellite orbiting a planetary body along with the planetary body.	
7	I1	If I=1, the orientation of the planetary (orbited) body will be computed from a force model starting from the initial conditions supplied on the PLANOR cards.	

IF CARD OMITTED: The orbit of the central planetary body can not
        be refined. In this case The trajectory of the central
        (orbited) planetary body must be supplied on either the
        standard planetary ephemeris or on the supplemental
        ephemeris. Also, without this card the orientation of the
        central body can not be modeled dynamically

NOTES:

1. When this option is used the REFSYS card must request the Earth
Equator and Equinox J2000 coordinate system for the reference.

2. When this option is used the elements of the planetary body must be
supplied before (first) the elements of the artificial satellites.
The elements of the planetary body are heliocentric J2000. The elements
of the artificial satellites are planet centered J2000.

3. Just below is an example of the PLANET card section of the global setup
when the INTGCB option is invoked. It is for a case when the orbit of
Mercury is being estimated along with an artificial satellite. Note that
the standard Mercury planet card has a VERY small GM value. Also note
that the last PLANET card is the one being used for Mercury and that this
card should also appear in the Gravity file (Unit 12).

```
INTGCB
PLANET    10100           2.20317821893582D-13        2440000.0 10000000.000
PLANET     0200           3.24858598826460D+14        6051900.0 10000000.000
PLANET     0300            .39860044150000D+15 .637813630D+07 .2982564D+03
PLANET     0301            .49028004760000D+130.173800000D+070.4608295D+04
PLANET     0400           4.28283697739390D+13        3397000.0       154.409
PLANET     0500           1.26712767857796D+17       71492000.0        15.414
PLANET     0600           3.79406260611373D+16       60268000.0        10.208
PLANET     0700           5.79454900707187D+15       25559000.0        43.616
PLANET     0800           6.83653406387926D+15       24764000.0        58.543
PLANET     0900           9.81600887707005D+11        1151000.0 10000000.000
PLANET     9999           1.32712440017987D+20      696000000.0 10000000.000
```

```
PLANET 1      1020020      2.20317821893582D+13      2440000.0 10000000.000
```

4. Starting with version 1507.12, the numerically integrated ephemeris
   of the central planetary body that is produced when the INTGCB card is
   present can be replaced with the XEPHEM option. This allows for the
   use of dynamic orientation while still using an input trajectory
   for the orbited central planetary body. When this is done, the
   gravitational torques computed for the dynamic orientation will use
   the positions from the external ephemeris.

2.3.50 IBMG2E

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
IBMG2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6       IBMG2E - Specifies that the interface
                  file output by GEODYN IIS on unit 11
                  will be for a GEODYN-IIE run on an IBM
                  compatible computer.

                  Information in the interface file
                  will be treated as follows:

                   Floating point - 64-bit IBM word.        64-bit IBM word.

                    Integers       - IBM 32-bit word.       null 32-bit IBM word
                                                            and 32-bit IBM word.

                    Logicals       - IBM 32-bit word.       null 32-bit IBM word
                                                            and 32-bit IBM word.

                    Alpha-numeric  - EBCDIC characters.     EBCDIC characters.


  IF CARD OMITTED: Interface file will be created for the Cyber computer.
```

2.3.51   INTCOM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
INTCOM                                  890601.    890701.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   INTCOM: Turns on the intercomparison
                        capability. This option allows the user
                        to perform certain specific orbit
                        generation runs. In these runs some
                        assumptions are made, or certain
                        perturbations only are turned on in
                        order to study the output orbit and/or
                        compare it with orbits generated by
                        similar software packages.
                        The output orbit is writen on unit59 at
                        a rate depending on the users request on
                        the ORBTVU card and expressed in inertial
                        True-of-Date Cartesian elements. [NOTE 2]
                        The assumptions and/or supressions for
                        each individual case are described under
                        Case Indicator on columns 9-10.

9-10   I2   Case Indicator: Integer number which indicates
                        a specific case. See NOTE 1 for description of
                        the individual cases.

25-44   D20.8   Start time for 3-hourly kp values storage   Epoch start
                        in the form YYMMDD. (Applies on Case 15)   time

45-59   D15.8   Stop time for 3-hourly kp values storage in   Epoch stop
                        the form YYMMDD. (Applies on Case 15)   time

NOTE [1]: 1   Two body orbit generation (point masses) - Output mean of reference
              system - Supressed precession and nutation - No other forces
              applied. (CASE1A of the TOPEX intercomparison)

          2   Two body - Output True-of-Date - Only precession and nutation
              applied. - No other forces applied.(CASE1B of the TOPEX
              intercomparison)

          3   Two body - Output Pseudo body-fixed - Fixed true pole - Tests
              Greenwich hour angle and UT1 - Modify POLE cards accordingly.
              (CASE1C of the TOPEX intercomparison)

          4   Two body - Output body fixed - UT1=UTC - Tests polar motion -
              corrections will be applied to UT1-UTC - Modify POLE cards
              accordingly. (CASE1D of the TOPEX intercoimparison).

          5   Two body - Output full body-fixed - Tests polar motion and UT1
              combined. (CASE1E of the TOPEX intercomparison).

          6   Case 2 - application of J2 (CASE2 of the TOPEX intercomparison).

```
      7   Case 2 + Point mass effects for other celestial bodies - Modify
          PLANET cards accordingly. (CASE3A of the TOPEX intercomparison).

      8   Case 7 + Indirect effect of the Earth's J2. (CASE3B of the
                  TOPEX intercomparison).

      9   Case 6 + Polar motion and UT1 (CASE4 of the TOPEX intercomparison).

     10   Case 6 + Complete gravity model GEM-T1.
          Tests Gravity Model. (CASE5 of the TOPEX intercomparison).

     11   Case 6 + Empirical along track accelerations - Include necessary
          ACCEL cards. (CASE6 of the TOPEX intercomparison).

     12   Case 6 + Solar radiation - Use SOLRAD card. (CASE7 of the TOPEX
          intercomparison).

     13   Case 10 + Simple solid Earth tide model - Use correct input
          on the TIDES cards (CASE8 of the TOPEX intercomparison).

     14   Case 10 + Complete Earth and Ocean tides. (CASE9 of the TOPEX
          intercomparison).

     15   Case 6 + Drag application using DTM atmospheric model -
          Constant fluxes are used - FLUX and ATMDEN cards are necessary.
          Three hourly Kp values are used - Include the right BIH tables
          on UNIT02. (CASE10 of the TOPEX intercomparison).

     16   All perturbations in Cases 2-15 applied. (CASE11 of the TOPEX
          intercomparison).

     17   Case 6 + Earth radiation - Use ALBEDO card AND SOLRAD card.
          (CASE12 of the TOPEX intercomparison).

     18   Case 6 + General relativity - Use REL300 card. (CASE13 of the
          TOPEX intercomparison).


NOTE [2]: OUTPUT FORMAT

        A. HEADER RECORD

        ITEM       FORMAT       DESCRIPTION

        1-132      A1           Description of the run. Contents of the second
                                COMMON TITLE card.

        B. EPHEMERIS RECORDS (Two records for each point)

        First record

        ITEM       FORMAT       DESCRIPTION

         1         D22.16       Julian Date (integral part) (UTC)

         2         D22.16       Fractional Julian Date (UTC)

         3         D22.16       Greenwich Hour Angle
```

```
4-6         3D22.16      Satellite X Y Z elements (meters)

Second record

1-3         3D22.16      Satellite Xdot Ydot Zdot elements (meters/sec)

 4           D22.16       Satellite geodetic latitude
                         (instantaneous z axis) (degrees).

 5           D22.16       Satellite East longitude (degrees).

 6           D22.16       Satellite height above the reference ellipsoid
                         (meters).


NOTE [3]:         Sample UNIT05 setups for the orbit generation
                  options exist in ZCDEP.TOPEX.UNIT05.DATA. The
                  GLOBAL TITLE cards describe the individual cases.



IF CARD IS OMITTED: No Intercomparison will take place.
```

2.3.52 INVERT

```
----+----1----+----2----+----3----+----4---+----5---+----6----+----7----+----8
INVERT 1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	INVERT - Controls various matrix inversion routine options.	
7	I1	= 0 Subroutine DSINV will be used to invert normal matrices. = 1 Subroutine SYMINV will be used to invert normal matrices.	0
8	I1	= 0 Inverted normal matrices will not be printed out. = 1 Inverted normal matrices will be printed out.	0
9	I1	= 0 Subroutine DSINV or SYMINV will be used to invert NORMAL POINT pass by pass normal matrices with a priori information as supplied from NORMPV card. = 1 A generalized inverse scheme will be used to invert NORMAL POINT pass by pass normal matrices. A priori information supplied from the NORMPV card will be ignored.	0
10	I1	= 1 The SRIF (square root information filter) (NOTE 1) option is invoked = 0 Default Inversion	

NOTE 1:   SRIF: A reliable and effective method for computing numerically
          accurate estimates in problems where high precision is required.
          Square root formulations increase numerical computation accuracy
          by guaranteeing positive-definiteness of the associated covariances
          and by decreasing the condition numbers of the normal matrices.

2.3.53 IONCOR

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
IONCOR
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	IONCOR - Requests the application of the ionospheric correction based on the ionospheric model IR-95. [Ref. 1]	
7	I1	Indicates the type of coefficients to be used in the model. [NOTE 1] = 0 CCIR coefficients = 1 URSI coefficients	0
8	I1	Indicates the type of interpolation to be used for electron density profiles. = 0 linear interpolation = 1 logarithmic interpolation (not tested yet)	0

NOTE [1]: CCIR - model recommended by the International Radio Consultative
          Committee (1967) (Ref. 1 p. 52).
      URSI - Model proposed by the International Union of Radio Science
          (1989) (Ref. 1 p. 52).
      Both sets of coefficient files must be included in the
      directory of the IIS execution. Files are located on geodesy2
      in /users/geodyn/SUPPORT/dat_ion95.
      There are 24 files, 12 files of each type, one for each month of
      the year. The filenames are in the following format: ccir*.asc
      and ursi*.asc where * is equal to the month plus ten.

NOTE [2]: Frequencies used in the computation of the correction are
      obtained in one of two ways:

      Option 1 - Frequencies provided. Nominal center or average
                 (over forward and return) frequencies per link
                 are included on columns 25-44 on the OFFSET input
                 cards. In this case an OFFSET card must be
                 included for each satellite in the run. Also
                 frequencies must be input on all the OFFSET cards
                 or option 2 will be invoked.
      Option 2 - Frequencies computed in GEODYN, invoked only when
                 one or more OFFSET cards do not provide frequencies,
                 or OFFSET cards are not included in the setup.

NOTE [3]: The earth orientation and flux tables used with the IONCOR
      option are special tables which include ionospheric indices.
      The analyst must use these tables with GEODYN IIS. However at this
      point TDF has not been modified to interpret the new tables format.
      With TDF runs the analyst should use the default GEODYN tables.

 [Ref. 1] Dieter Bilitza, "International Reference Ionosphere 1990.",
      Nov. 1990. NSSDC/WDC-A-R&S 90-92.

2.3.54 J2SUN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
J2SUN                   2.11060885327268D-07        1.D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6      J2SUN  - Introduces J2 of the SUN as a parameter

25-44   D20.8   J2 of the sun value

45-59   D15.3   Sigma for J2
```

2.3.55 L2LOVE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
L2LOVE                  .075
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	L2LOVE - Requests that solid earth tide coefficients of the third kind be modified and/or adjusted.	
7	I1	If > 0, print solid tide correction to station height. [NOTE 1]	
25-44	D20.8	A priori value of love number of the third kind to account for horizontal shearing. (L2)	.075
45-69	D15.3	A priori sigma of L2 . If greater than zero, requests adjustment of L2 .	0.

NOTE [1]: Solid tide induced changes in station height printed
           on unit 98.

IF CARD OMITTED: Default value (L2 = 0.075) will be used

2.3.56   LINK

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
LINK
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LINK - This option links two GEODYN parameters together. During the formation of the normal matrix, the partials of the second parameter will be folded into the partials of the first parameter. The computed correction will adjust both parameters.	
8-12	I5	ID number of the first adjusted parameter [NOTE1]	
13-17	I5	ID number of the second adjusted parameter [NOTE1]	

NOTE 1: The adjusted parameter ID number can be found in the IIS
     parameter summary.

IF CARD OMITTED: No parameter linking will occur.

2.3.57   LIST

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
LIST
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-4   A4   LIST - If NOLIST option has been exercised
                 earlier in Global Set options, then LIST
                 option will negate effects of NOLIST and
                 cause GEODYN-IIS to resume listing of
                 input from this point forward.

IF CARD OMITTED: Listings of input will terminate with 'NOLIST' or 'ENDALL'
                 whichever is encountered first.

2.3.58 LNSTHR

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
LNSTHR
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   LNSTHR - is used to modify the model for the
                 relativistic Lense-Thirring effect and/or
                 solve for related parameters.

                 1. The Lense-Thirring model introduce a
                 paramter which multiplies the acceleration
                 due to the Lense-Thirring effect in the form
                 (1 +).

                 2. A parameter related to a force described
                 as Yukawa-type force. The acceleration due to
                 this force is given by

$$\vec{A} = \alpha \frac{GM(1 + KR)}{R^3} e^{-KR} \vec{R}$$

                 where:
                 α - is the parameter
                 G - the gravitational constant
                 M - the mass of the earth
                 K - $1/\lambda$; λ is the range of the force
                 $\vec{R}$ - is the position vector of the satellite

7   I1   1 - data for mu (μ)
                 2 - data for alpha (α)

18-24   I7   Satellite Id.

25-44   D20.8   Parameter value   0.D0

45-59   D15.3   Parameter sigma   0.D0

73-80   D8.2   If col7 = 2 this specifies the range of
                 the force

IF CARD OMITTED: The above models will not apply to the force model.

2.3.59 LOCALG

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
LOCALG
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LOCALG - Requests appliation and possibly estimation of gravity anomalies. Gravity anomalies [1] are regional (local) departures from the gravity field implied by the input set of spherical harmonics. The location of the gravity anomaly is specified on a second card [2].	
7-14	I8	Gravity Anomaly number. This is a unique number specified by the user to identify the gravity anomaly parameter. No two gravity anomaly parameters may use the same gravity anomaly number. Information about the area of the gravity anomaly parameter is input on a grid [3]. The gravity anomaly number helps link up information from the grid to the gravity anomaly parameter.	
18-24	I7	Grid Number [3]. Information about the gravity anomaly area is given on an external grid. The grid number identifies the grid which is being used. All gravity anomaly parameters in the same run must use the same grid.kk	
25-44	D20.8	A priori value of the gravity anomaly at the center of the master block. [2]	mgals
73-80	D8.3	Standard deviation of gravity anomaly. A value > 0 results in estimation of gravity anomalies.	

Note [1]   The parameters are free air anomalies on the surface of
                a sphere with radius (a*a*b)**(1/3) where a is the semi
                major axis and b is the semi minor axis of the central
                body.

Note [2]   A card which is blank in COLs 1-6 must follow each
                LOCALG card. This second card contains information
                in COLs 7-66 about the location of the gravity anomaly.

Note [3]   When LOCALG parameters are present, IIS searches for
                a data set called SUBBLK. SUBBLK contains points which
                are assigned to the LOCALG parameters. The points represent
                subdivision areas of the LOCALG parameters and are used
                to numerically integrate the equations which upward continue
                the gravity anomaly to the satellite location.

SUBBLK is a formatted data set as follows:

```
7-14     I8     Gravity Anomaly number. This is a unique number
                for LOCALG parameters. At least one (preferably
              more than one) grid point will match each LOCALG
                parameter's gravity anomaly number.

18-24    I7     Grid Number. This is a number which uniquely
                identified the grid (all points on the grid have
                the same grid number.

25-49   D25.16 Geocentric latitude of grid point (degrees)

50-74   D25.16 Longitude of grid point (degrees)

75-99   D25.16 Area on unit sphere represented by the grid point


IF CARD OMITTED: Gravity anomalies will not be applied.


SECOND CARD
-----------


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT           DESCRIPTION                      DEFAULT VALUE & UNITS

1-6      A6              Contains information about master
                         block and its subdivisions.

 7-21    D15.2           Latitude of the center of the master                 deg
                         block.

22-36    D15.2           East longitude at the center of the                  deg
                         master block.

37-51    D15.2           Size of the master block in the direction            deg
                         of latitude.

52-66    D15.2           Size of the master block in the direction            deg
                         of longitude.

IF CARD OMITTED:        And LOCALG was requested the program will
                        terminate abnormally.
```

2.3.60   LRARC

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
LRARC 17 5 5 5
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests input of laser retro-reflector range corrections on UNIT 8 [NOTE 1] (Currently, only applies to TOPEX)	
7-8	I2	Number of incidence angles for which information is available on UNIT 8	17
9-10	I2	Maximum Order of Fourier Coefficients for X-coordinates	5
11-12	I2	Maximum Order of Fourier Coefficients for Y-coordinates	5
13-14	I2	Number of Station Detector Types in Range Correction Tables	14
23-24	I2	=1 This is the SARAL satellite and an LRA correction will be applied.'	

NOTE 1:   This corrects the observation from the reflecting corner cube
           back to a fixed point on the spacecraft. It is also station
           dependent and is tied to the laser tracking station detector
           type specified on the INSTRMNT card. This must be used in
           conjunction with the OFFSET and CGMASS cards to get the
           complete range correction from the corner cube to the
           spacecraft CG.

           Currently, this option can only be used for the TOPEX
           satellite.

IF CARD OMITTED: No lra range corrections will be read or used.

2.3.61   MLTDEM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ENDCON
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

1-6     I6          ENDCON: End of configuration
                    Will be followed by an ENDSIM card
                    if this is the last configuration.
                    Will be followed by a SIMSAT card
                    if another configuration is requested.



IF CARD OMITTED: If simulated data generation (not replacement ) is
                 invoked and this card is missing the run will
                 terminate.
```

2.3.62   NETCON

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NETCON                                    1.331          0.896        4.789
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                      DEFAULT VALUE & UNITS


1-6     A6      NETCON - Introduces values for the right
        hand side equations and sigmas for
        network rotation and/or translation constraints

 7      I1      = 1 The values represent station network
        translation constraints
                = 2 The values represent station network
        rotation constraints
                = 3 The values represent quasar network
        rotation constraints

 8      I1      = 1 The values represent RHS values
                = 2 The values represent sigmas

25-44   D20.8   RHS x compopnent value OR sigma

45-59   D15.3   RHS y compopnent value OR sigma

60-72   D13.1   RHS z compopnent value OR sigma


 NOTE [1] :

UNITS:  KM =Kilometers; M  =Meters     ; S  =Seconds     ; M/S=Meters per second
        H  =Hertz      ; MH =Mega-Hertz;

IF CARD OMITTED:  No network translations or rotations wil be invoked
```

2.3.63   NOLIST

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NOLIST
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   NOLIST - Will cause GEODYN-IIS listings
                 of input to be interrupted from point of
                 NOLIST until next LIST option encountered.

IF CARD OMITTED: Listings will terminate with 'ENDALL'.

2.3.64 NONSNS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NONSNS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NONSNS - Shuts off the "No Shirt No Service" (NSNS) protection in a GPS data reduction run. Unless this card is present, NSNS protection is provided in a GPS data reduction run. When NSNS protection is in force, every block of GPS data that is not covered by an ambiguity bias (simple measurement bias) is edited.	

IF CARD OMITTED: NSNS protection is provided.

2.3.65 NORMPT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NORMPTO              120
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests the computation and output onto unit 20 in GEODYN-IIE of metric data normal points on the last inner iteration of each data reduction arc during the last global iteration.	
7	I1	Indicates whether or not a normal point report should be printed on unit 15 by GEODYN-IIE. 0 - Print a normal point report on unit 15. 1 - Do not print a normal point report.	0
8	I1	Maximum number of local iterations to perform in editing each pass of data prior to formation of normal points.	5
9-10	I2	Maximum number of physical buffers to be used in outputting normal points to unit 20.	2
11-14	I4	Controls the maximum number of observations that will be used in one data block (minimum no. = 11 , maximum = 9999, default value = 40 when EMATRX option is used)	1000
15-17	I3	Number of integration steps over which interpolation may be simultaneously performed. Must be greater than or equal to integration order minus one.	Integration order minus one.
18-20	I3	Maximum number of physical buffers per input observation block. This number must be greater than or equal to the value used by the Tracking Data Formatter.	10

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
21-24	I4	Normal point bin size in seconds. If a positive integer is not entered in this field, normal points will not be generated.	None
25-44	D20.8	Normal point pass editing multiplier. (See Arc EDIT option for default)	Residual edit multipler.
45-59	D15.3	Normal point pass editing initial RMS. (See Arc EDIT option for default)	Editing RMS from previous Inner Iter.
73-80	D8.2	Normal point pass editing iteration convergence criterion. (See Arc EDIT)	Inner Iteration RMS convergence.

NOTES:
 [1]   When in normal point generation mode, large numbers of parameters should
       not be estimated. This option also overrides columns 11-17 of the
       VECOPT card. Observation data to be input for normal point generation
       should be processed through the Tracking Data Formatter with the normal
       point option exercised in TDF.

       Values in columns 11-14 and 15-17 of this card override values in these
       same columns on VECOPT option.

       See also Arc Set option card NORMPV.

IF CARD OMITTED: Normal points will not be generated.

2.3.66   NUTATE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NUTATE
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NUTATE - Requests the application of nutation corrections that refer to the IAU-2000 model and/or used to modify and/or request adjustment of corrections to nutation components DPSI (nutation in longitude) and EPST (nutation in true obliquity).	
7	I1	= 0 No parameter adjustment only nutation corrections since J2000 are applied.[NOTE 1]	0
		= 1 Parameter adjustment requested with no nutation corrections applied.	
		= 2 Parameter adjustment requested and nutation corrections since J2000 are applied.	
25-44	D20.8	Date in form YYMMDD.FFF of DPSI and EPST correction values[1] to which this card applies. This date is for the midpoint of the interval specified in columns 25-44 of card two.	No default.
45-59	D15.3	DPSI (nutation in longitude) correction.	See col. 8. (SA)
60-72	D13.1	EPST (nutation in true obliquity) correction.	See col. 8. (SA)

[NOTE 1]   Use the NUTATE card with the new EOP IAU 2000 tables to apply nutation corrections since year 2000.

SECOND CARD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
                        5.0             0.01            0.1             0.1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-23	23X	Blanks must be present.	
24	I1	=1 the units for the below averaging interval is hours =0 the units for the below averaging interval is days	0
25-44	D20.8	Averaging period[1] in the above units for	No default.

```
                 DPSI and EPST values. The date in columns
                 25-44 of the first card is for the midpoint
                 of this interval

45-59    D15.3  A priori standard deviation in DPSI.        0.0    (SA)

60-72    D13.1  A priori standard deviation in EPST.        0.0    (SA)

IF CARD OMITTED:  The nutation correction will not be applied.
```

2.3.67   OBSVU

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OBSVU 3           0010
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	OBSVU - Controls residual printout for all arcs.	
7	I1	Residual printout controlled as follows:	0

=0   or blank - Indicates that
     residuals are requested on the
     first inner iteration of the first
     global iteration and the last inner
     iteration of the last global
     iteration for all arcs. This is the
     same as =3 below.

=1   Indicates that residuals are
     requested on the first inner
     iteration of the first global
     interaction for all arcs.

=2   Indicates that residuals are
     requested on the last inner
     iteration of the last global
     iteration for all arcs.

=3   Indicates that residuals are
     requested on the first inner
     iteration of the first global
     iteration and the last inner
     iteration of the last global
     iteration for all arcs.

=4   Indicates residuals are
     requested on all iterations for
     all arcs.

=5   Indicates no residuals are
     requested for any arc.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
8	I1	= 1 Indicates preprocessing corrections are to be written on unit 16 for the iterations indicated by column 7 and for the modulo selected in columns 21-24. Residuals must be printed on the first iteration if the option is invoked.	0

[see NOTE 1 below]

21-24   I4   Modulo number for printing of   1
                 residuals, preprocessing corrections,
                 and partials. Default is to print all
                 residuals. A value N input here requests
                 printing of every Nth residual.

NOTE[1]:   The numbering system that is used on the preprocessing
                      printout on UNIT16 is related to the Header Record and
                      partition number as described in Volume 5 Section 2 under
                      Observation Corrections Record.
                      [eg. if the UNIT16 printout was for a range measurement
                      and the number printed was 13 it would mean Header #1
                      partition #3 which would pertain to a dry tropospheric
                      refraction correction for station #1. G means that the
                      program computes and applies the correction. Absence of
                      a "G" means the correction was provided by the data record.]

IF CARD OMITTED: Residuals are requested on the first inner iteration of
                  the first global iteration and the last inner iteration
                  of the last global iteration for all arcs. No preprocessing
                  nor measurement partial files are created and all residuals
                  in the given iteration are output.

2.3.68   OFFADJ

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
OFFADJ
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OFFADJ - Provides for the adjustment of tracking point offset coordinates on a satellite. This card must be used in conjuntion with a OFFSET card. The OFFSET card describes the tracking point coordinate parameters. Columns 7-44 of the OFFADJcard must match columns 7-44 of the OFFSET card which corresponds to the tracking point coordinates for which the adjustment is desired.	
45-59	D15.3	Standard Deviation of X coordinate	(meter)
60-72	D13.1	Standard Deviation of Y coordinate	(meter)
73-80	D8.2	Standard Deviation of Z coordinate	(meter)

2.3.69   OFFSET

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OFFSET          7806401 0.                   1.331        0.896       4.789
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OFFSET - Inputs body-centered coordinates for antenna offset or laser reflector offset.	
7	I1	= 1 Indicates link 1 of offset. A second link (OFFSET2) must follow. = 2 Indicates link 2 of offset. [NOTE 1], [NOTE 2] = 3 Indicates link 3 of offset. [NOTE 1], [NOTE 2] = 7 Antenna orientation vector in the x direction = 8 Antenna orientation vector in the y direction = 9 Antenna orientation vector in the z direction [NOTE 6], [NOTE 7]	0
8	I1	= 9 Indicates external attitude model used for link # 1 rotations and link # 2 and # 3 movable antenna rotations. Must have external attitude file available. If this option is selected an antenna # in column 17 must be present, only antenna #'s 1-4 are valid. This option overrides the coordinate system specified in column 15. Not applicable for OFFSET2 or OFFSET3 card. OFFSET1 card value is used for OFFSET2 and OFFSET3. [NOTE 2]	0
9	I1	= 1 Indicates use of new metric data format prepro word antenna idenfication scheme. If this option is selected an antenna # in column 17 must be present, only antenna #'s 1-4 are valid. Not applicable for OFFSET2 or OFFSET3 card. OFFSET1 card value is used for OFFSET2 and OFFSET3. [NOTE 3]	0
10	I1	= 1 Indicates use of OFFSET3 card. = 0 No OFFSET3 shall be used.	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
11-12	I2	Antenna type number used for phase map corrections	

```
14-15   I2      Body fixed coordinate system                        0
                used to calculate offset. [NOTE 4]

                   0 - Position and velocity vectors
                   1 - Position and sun vectors
                   2 - TOPEX/Poseidon
                   3 - SPOT-2
                   4 - GPS
                   5 - ERS-1
                   6 - Mars observer Mapping Phase
                   7 - Mars observer Cruise Phase
                   8 - TDRSS
                   9 - Magnetically stabilized S/C
                  10 - GFO
                  11 - TRMM
                  12 - EUVE
                  13 - ICESAT
                  14 - ENVISAT
                  15 - CRYOSAT-2
                  16 - Leading GRAIL satellite
                  17 - Trailing GRAIL satellite
                  18 - HY2A
                  19 - SARAL
                  20 - SENTINEL

                Not applicable for OFFSET2 or OFFSET3 card.
                OFFSET1 card value is used for OFFSET2.

16-17   I2      Antenna number (optional if frequency
                is specified). Mandatory if external attitude
                or new metric data antenna identification
                scheme is selected. This antenna number must
                match the appropriate external attitude file
                antenna number and/or the metric data antenna
                number.
                Not applicable for OFFSET2 or OFFSET3 card.
                OFFSET1 card value is used for OFFSET2 and
                OFFSET3.

          OR

                50+ Laser Id if Laser Altimeter data are being
                processed. If the laser Altimeter Id is 1 then
                the user should put 51 on columns 16-17. This
                convention distinguishes from the antenna number
                and the antenna identification scheme in the
                GEODYN code.


COLUMNS FORMAT          DESCRIPTION                     DEFAULT VALUE & UNITS

18-24   I7      Satellite ID (required).                            0
                Not applicable for OFFSET2 card.
                OFFSET1 card value is used for OFFSET2.

25-44   D20.8   Frequency in mega-hertz. Used to                    0.        MH
                discriminate between antennae when
                more than one antenna is on a satellite.
```

```
                ( Frequency = 0. implies that offset
                applies to all antenna.)
                Not applicable for OFFSET2 or OFFSET3 card.
                OFFSET1 card value is used for OFFSET2.
                (optional if antenna number and
                new prepro ID scheme selected).

                If the index in column 7 is equal to 7
                then this field contains the first component
                of the orientation unit vector in the x direction

                If the index in column 7 is equal to 8
                then this field contains the first component
                of the orientation unit vector in the y direction

                If the index in column 7 is equal to 9
                then this field contains the first component
                of the orientation unit vector in the z direction


 45-59   D15.3  Body centered fixed offset link 1 or              0.        M
                link 2 or link 3 antenna from center of
                figure; x-axis.

                If the index in column 7 is equal to 7
                then this field contains the second component
                of the orientation unit vector in the x direction

                If the index in column 7 is equal to 8
                then this field contains the second component
                of the orientation unit vector in the y direction

                If the index in column 7 is equal to 9
                then this field contains the second component
                of the orientation unit vector in the z direction


 60-72   D13.1  Body centered fixed offset link 1 or              0.        M
                link 2 or link 3 antenna from center of
                figure; y-axis.

                If the index in column 7 is equal to 7
                then this field contains the third component
                of the orientation unit vector in the x direction

                If the index in column 7 is equal to 8
                then this field contains the third component
                of the orientation unit vector in the y direction

                If the index in column 7 is equal to 9
                then this field contains the third component
                of the orientation unit vector in the z direction


 73-80   D8.3   Body centered fixed offset link 1 or              0.        M
                link 2 or link 3 antenna from center of
                figure; z-axis.
             OR Antenna Cutoff angle if the index on col. 7
```

is "9"

NOTE [1] : OFFSET1 and OFFSET2 cards are a pair. OFFSET1 card must be
           followed by OFFSET2 card. If present, OFFSET3 must follow
           OFFSET2.

NOTE [2] : See Volume 5 for a description of the external attitude file.
           Multiple link offset may only be used with Mars observer
           (Col 15 = 6) and external attitude. Using multiple links implies
           link # 1 is Spacecraft Body Fixed (SBF) Frame, and link # 2 is a
           movable link. Link 1 and CGMASS vector are in the same SBF frame
           Link # 2 gets rotaton from external attitude or internal attitude
           model. If q1 of quaternions equals -9999999 for any point in the
           block, then the internal model (selected in col. 15) will be used
           for the offset vector rotations. If no SBF to J2000 quaternions
           are found for the antenna number requested then the internal model
           (selected in col. 15) will be used for the offset vector rotations.
           If no movable antenna quaternions are present in the external
           attitude file only the 1st link will be applied with the SBF to
           J2000 quaternion information.

NOTE [3] : See the antenna identification word in the metric data format
           description.

NOTE [4] : The two vectors listed for each group are the initial vectors used
           to describe the satellite body fixed coordinate system.
           (options 0 and 1 only)

           Position and velocity vectors - The X-axis is given by the velocity
           vector, the X-axis crossed with the position vector gives the
           Y-axis, and the X-axis crossed with the Y-axis gives the Z-axis.

           Position and sun vectors - The Z-axis is given by the negative of
           the position vector, the Z-axis crossed with the sun vector gives
           the Y-axis, and the Y-axis crossed with the Z-axis gives the X-axis.

NOTE [5] : See CGMASS for reference between center of figure/center of gravity.

NOTE [6] : The default values for the antenna orientation vectors
           for GPS satellites
           x = (1,0,0)
           y = (0,1,0)
           z = (0,0,1)

           for user satellites
           x = (1,0,0)
           y = (0,-1,0)
           z = (0,0,-1)

NOTE [7] : If the index in column 7 is 7, 8 or 9
           then the user needs to fill the satellite ID (cols 18-24)
           and the first 3 real fields with the antenna orientation
           in all 3 directions.

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second
        H  =Hertz      ; MH =Mega-Hertz;
```

IF CARD OMITTED: No antenna offset will be applied.

2.3.70 OLOAD

The OLOAD option may be used for two different parameter estimation options
in GEODYN.
1. Application and Estimation of Ocean Loading
1. Application and Estimation of Center of Mass (COM) corrections and Earth
   Orientation and UT1 (EOP/UT1) corrections caused by high frequency tides.

The description below refers to Ocean Loading application and estimation.
(For Tidal driven COM corrections and EOP/UT1 corrections please scroll down)

We attach here a reference by Richard Ray on Background to GEODYN Modeling of Diurnal/Semi

```
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
OLOAD  3  7051    273555 -.00378            +.00378          10.          10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OLOAD - Requests application and/or adjustment of ocean loading using the formulation described in NOTES [4, 5 and 6]. Also see NOTE [1]	
7	I1	Print Options (See NOTE [3] below)	
8	I1	Direction specification. 1 - East, 2 - North, 3 - Vertical	3
11-14	I4	Site Number (See NOTE [8] below)	
18-24	I7	Doodson number. (see NOTE [7] below)	0
25-44	D20.8	"A" coefficient.	0.0 M
45-59	D15.3	"B" coefficient.	0.0 M
60-72	D13.1	Sigma "A".	0.0
73-80	D8.2	Sigma "B".	0.0

NOTES:

[1] In the second half of 2017, R Ray and D Rowlands scrubbed most
    aspects of tide modeling in GEODYN (solid Earth tide displacements
    for stations were not re-examined, although dynamic Earth tides,
    ETIDES were). The re-examination resulted in some code changes
    that were implemented in version 1802.0. Using the same OLOAD
    setup decks as in previous versions will result in slightly
    different ocean loading displacements due to a cleanup of
    sideband computations. Xp and YP computations have changed
    quite a bit (see note [10]. One should not attempt to
    model Xp and Yp with OLOADS prior to version 1802.0.
    Furthermore, some input changes are recommended on this web page.

[2] NOTES [3 & 4] pertains to ocean loading corrections only.
    NOTES [5-8] pertain to ocean loading, center of mass variations
    and Earth orientation. NOTES [9-11] pertain to center of mass
    and Earth orientation

[3] Ocean loading station lat, lon, height changes printed on unit 96.

[4] GEODYN uses the following formula to compute the change
    in a component (East, North or Vertical) of position due
    due to the loading of the ith tide (a tide is specified
    by a Doodson number):

    delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(arg(i,t))
    The argument, arg(i,t), is mainly (see notes [5i and 6]) a
    linear combination of certain astronomical angles at time, t.
    The factors factors of the linear combination are dictated by
    the input Doodson number.

[5] In order to be consistent with the tidal community,
    for certain Doodson numbers, arg(i,t) is offset by
    an amount given in the table that follows just below
    NOTE that for the dynamic Earth and ocean tides (ETIDES
    and OTIDES) the angle by which the Doodson number is offset
    is defaulted to zero for all tides. It is up to the user
    specify a multiple of PI/2 to offset the dynamic tides.

Doodson   OFFSET   TIDE

165555   PI/TWO   ! K1
145555   -PI/TWO ! O1
163555   -PI/TWO ! P1
135655   -PI/TWO ! Q1
055565   PI   ! Node tide
117655   -PI/TWO ! alpha1
125755   -PI/TWO ! 2Q1
127555   -PI/TWO ! sigma1
137455   -PI/TWO ! rho1
147555   PI/TWO   ! tau1
153655   PI/TWO   ! beta1
155455   PI/TWO   ! M1 couplet line
155655   PI/TWO   ! M1
157455   PI/TWO   ! chi1
162556   -PI/TWO ! pi1
164554   PI/TWO   ! S1 gravitational
164555   PI   ! S1 met line, not gravitational
164556   PI/TWO   ! S1 gravitational
166554   PI/TWO   ! psi1
167555   PI/TWO   ! phi1
173655   PI/TWO   ! theta1
175455   PI/TWO   ! J1
183555   PI/TWO   ! SO1
185555   PI/TWO   ! OO1
195455   PI/TWO   ! upsilon1
253755   PI   ! Gamma2
254556   PI   ! alpha2
263655   PI   ! lambda2
265455   PI   ! L2

```
            274554    PI         ! R2
            355555    PI         ! M3


    [6]  Starting with version 1802.0, alterations due to
         sidebands are automatically computed for every
         OLOAD input (whether for actual ocean loading or for
         tidally driven center of mass or EOP changes). Prior
         to version 1802.0, sideband computation was performed
         according to what was being sone with the same Doodson
         number in the dynamic tides. There were multiple
         problems with this approach, Sideband modeling
         slightly modify arg(i,t) (described above)
         and also scale the A and B coefficients. NOTE
         that sideband computations are also possible for the
         parameters associated with OTIDES and ETIDES cards, but
         for these the user must request these sideband computations,
         The OLOAD parameters use sideband option #1 as described
         on the OTIDES card.


    [7]  Any number specified in columns 18-23 specified as a Doodson number
         having a leading digit greater than 6 will be interpreted as a
         retrograde tide having the same Doodson number but with 6 less in
         the leading digit. For example, 855555 is a retrograde M2 tide
         (255555).



    [8]  In addition to describing parameters that model station
         displacements due to ocean loading, the OLOAD card
         can also describe parameters for the Earth's center
         of mass variations and also variations in Earth orientation
         parameters (Xp, Yp and UT1). Site number 1 is reserved for
         (indicates that the card pertains to) center of mass
         variations. Site number 2 is reserved for (indicates that the
         card pertains to) Earth orientation. For use of the OLOAD
         card for center of mass or Earth orientation, scroll down


UNITS:  KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees    ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds


IF CARD OMITTED: Ocean loading will not be used.

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OLOAD  1    2     875555        -1.3832215D-10  2.5079538D-11
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & U
NITS


1-6     A6      OLOAD - Requests application and/or
                adjustment of Center of Mass OR  Earth
                Orientation (EOP) and UT1 corrections
                driven by High Frequency Tides
                (See NOTE [1] and NOTE[9])


8       I1      Type of parameter
```

```
                      For column   14=1
                                    1=X direction
                                    2=Y direction
                                    3=Z direction

                      For column   14=2
                                    1=Xp and Yp (Polar Motion)
                                    3=UT1


14        I1        Index defining the Group of Parameters

                    1 - Center of Mass correction   (See NOTE[10])
                    2 - EOP/UT1 correction          (See NOTE[11])


18-24     I7        Doodson number. (See NOTES 5 and 6 above)        0
                                                                      COM/EOP/UT1
25-44     D20.8     "A" coefficient.                                 0.0 M /RAD/ S
                                                                      COM/EOP/UT1
45-59     D15.3     "B" coefficient.                                 0.0 M /RAD/ S

60-72     D13.1     Sigma "A".                                       0.0

73-80     D8.2      Sigma "B".                                       0.0
```

   [9] Suggested OLOLAD setups for center of mass and EOP
are provide on this webpage. The corrections that result
from these setups are also provided for a 10 day period
in 1994. These corrections have been compared to corrections
provided by other researchers.

  [10] The sense of the center of mass correction is that after it
is added to coordinates given in the terrestrial reference
frame of the stations, the coordinates are in a center of
of the Earth's mass frame consistent with satellite orbits.
GEODYN uses the following formula to compute the center of
mass correction in a component (X, Y or Z) of position due to
of the ith tide (a tide is specified by a Doodson number):

delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(arg(i,t))

The argument, arg(i,t), is mainly (see notes [5] and 6]) a
linear combination of certain astronomical angles at time, t.
The factors factors of the linear combination are dictated by
the input Doodson number.

  [11] The sense of EOP corrections is that when they are added to
a smooth time series of EOP the resulting EOP series is closer
to observed values.

UT1

The UT1 correction due to the ith tide (a tide is specified
by a Doodson number) is computed according to the following
formula:

delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(arg(i,t))

The argument, arg(i,t), is mainly (see notes [5i and 6]) a
linear combination of certain astronomical angles at time, t.
The factors factors of the linear combination are dictated by
the input Doodson number.
Xp and Yp

Xp and Yp corrections are linked together. Richard Ray has
prepared a PDF to give more background on this. The PDF can
be download from this webpage.
The correction due to the ith tide for Xp and Yp is linked
by a common pair of A and B coefficients.

deltaXp(i,t)= A(i) * cos(arg(i,t)) - B(i) * sin(arg(i,t))
deltaYp(i,t)=-B(i) * cos(arg(i,t)) - A(i) * sin(arg(i,t))

The argument, arg(i,t), is mainly (see notes [5i and 6]) a
linear combination of certain astronomical angles at time, t.
The factors factors of the linear combination are dictated by
the input Doodson number. This approach requires the use of
both prograde and retrograde tides. See NOTE [7].

EXAMPLE SETUPS AND CORRECTIONS FOR EOP AND COM

EOP

EXAMPLE SETUP FOR EOP OLOAD CARDS

(These coefficients are based on the ocean tide "Model C" from the paper by
Chao, Ray, Gipson, Egbert, & Ma (JGR, 1996), with minor constituents
inferred from a Munk-Cartwright Fourier series expansion of the tidal
admittances. The tidal model is the same one that was adopted for
the IERS-2010 Conventions, although the coefficients themselves are slightly
different owing to various translations done by the IERS.)

These corrections are consistent with the suggested EOP input

When comparing our EOP coefficients to those tabulated by the IERS, there
are some important differences. The main one is a different convention for
the tidal arguments. In addition, the IERS explicitly
tabulates all nodal sidelines. This must NOT be done for GEODYN,
because GEODYN internally computes all needed lunar nodal modulations
(as well as perigee modulations for M1 and L2). Thus, a GEODYN set of
EOP coefficients will always be smaller than the corresponding table of
IERS coefficients, at least when the same tidal constituents are being
included. Please see the reference by Richard Ray on:
Background to GEODYN Modeling of Diurnal/Semidiurnal Tidal Polar Motion

COM

EXAMPLE SETUP FOR COM OLOAD CARDS

(These coefficients are based on the GOT4.10c ocean tide model, which
is a small revision to the GOT4.10 model described by Ray (JGR-Oceans,

118, 4570, 2013), with the revision being a more rigorous accounting
for tidal geocenter motion during the model development, as described
by Desai & Ray (GRL, 41, 2454, 2014).)

    These corrections are consistent with the suggested COM input - X component

    These corrections are consistent with the suggested COM input - Y component

    These corrections are consistent with the suggested COM input - Z component

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Tidal driven EOP/UTI or COM corrections will not be applied

2.3.71 OTCOEF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OTCOEF
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   Provides the apriori values for the
                  S coefficients needed for the ocean
                  tide model evaluation. This card applies
                  to the ocean tide model that employs
                  Proudman functions.

7-8   I2   Tidal constituent identification number

                      = 0   M2
                      = 1   K2
                      = 2   S2
                      = 3   N2
                      = 4   K1
                      = 5   O1
                      = 6   P1
                      = 7   Q1

25-44   D20.8   A priori value for C coefficient.   0.

45-59   D15.3   A priori value for S coefficient.   0.

60-72   D13.1   Standard deviation for C coefficient.   0.
                  No adjustment if this field is zero.

73-80   D8.2   Standard deviation for S coefficient.   0.
                  No adjustment if this field is zero.

NOTE [1]: A stream of OTCOEF cards should follow the OTMOD card
           (See OTMOD Vol. 3).

IF CARD OMITTED: and OTMOD has been requested the run will terminate
                  abnormally.

2.3.72   OTIDEN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OTIDEN+1   2 2 +1220 011 -.0224744          +.0192629       10.        10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```


COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OTIDEN - Requests application and/or adjustment of ocean tides using the Colombo tide model and normalized Legendre polynomials. M and K symmetry is taken into account.	
7-8	I2	Indicates sign (+ or -) term in harmonic expansion.	+1
9	I1	Indicates form of input coefficients.	0
		0 = A and B coefficients. [NOTE 1]	
10	I1	Indicates form of input sigmas.	0
		0 = A and B coefficients. [NOTE 1]	
11-12	I2	Degree of expansion.	0
13-14	I2	Order of expansion.	0
15-17	I3	Sign (+1 or -1) of the Demos Number. [NOTE 2]	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2]	0
		$\qquad$ M = 0,1,2 $\qquad$ K = 0,1,2 $\qquad$ H = 0,1,2	
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
23	I1	Indicates form of tidal amplitude coefficient [$V_f(t)$ / $\bar{V}_f$] [NOTE 3]	0
		0 = only main line, fixed coefficient 1 = main line and sidebands, variable coefficient 2 = only main line, variable coefficient	
24	I1	Disturbing Body (B). [NOTE 2]	0
		0 = Moon and Sun 1 = Moon	

```
                 2 = Sun


25-44   D20.8   "A" coefficient. [NOTE 1]                          0.    M
                (Amplitude)


45-59   D15.3   "B" coefficient. [NOTE 1]                          0.    M
                (Phase)


60-72   D13.1   Sigma "A".                                         0.    M
                (Amplitude)


73-80   D8.2    Sigma "B".                                         0.    M
                (Phase)
```


NOTES:

 [1]   The "A" and "B" coefficients are related to amplitude and phase
         by the following formulas:

              A = amplitude * cos(phase)
              B = amplitude * sin(phase)

 [2]   The "Demos Number" is represented in the Parameter Label (Word #2)
         as follows:

```
        **************************************************************
        *   SIGN OF   *                                *  SIGN OF   *
        *   HARMONIC  *     MKH*1000+(J+10)*10+B        *  DEMOS     *
        *   EXPANSION *                                *  NUMBER    *
        **************************************************************
```

 [3]   There are 30 recognized main tidal lines.
         Their Demos numbers are:

```
      SMKH   JB                             SMKH   JB   (See page 1 for S M K
                                                         J B definitions)
      -1020  02                            -1020  11
       1001 -11                             1120  11
      -1001  11                             1101  11
      -1020  01                            -1101 -11
       1120  01                             1101 -11
       1120  02                            -1101  11
       1101  01                            -1120  01
      -1101  01                             1220  21
       1101  02                             1220  11
      -1101  02                             1220 -11
       1101  00                             1201  01
       1220  01                            -1201  01
       1220  02                             1201  02
       1001 -12                            -1201  02
      -1001  12                             1201  00
```

Of these 30 main lines there are 18 distinct frequencies. The side bands
associated with these 18 main line frequencies are:

```
Main Line 1: Ssa   -1020   02
Side Bands:         1001  -22

Main Line 2: Mm    1001  -11,   -1001   11
Side Bands:        -1021   11,   -1011   11,    1011  -11,    1021  -11,
                   -1020  -11,   -1010  -11,    1002   11,    1012   11

Main Line 3: Mf    -1020   01
Side Bands:        -1021   21,   -1011   21,    1001  -21,    1011  -21,
                    1021  -21,   -1010   01,   -1000   01,    1012   01

Main Line 4: O1     1120   01
Side Bands:        -1112   01,    1100   01,    1110   01,   -1111  -21,
                    1101   21,    1111   21,    1121   21

Main Line 5: P1     1120   02
Side Bands:         1101   22

Main Line 6: K1     1101   01,   -1101   01,    1101   02,   -1101   02,    1101   00
Side Bands:        -1121   01,   -1111   01,    1111   01,    1121   01

Main Line 7: M2     1220   01
Side Bands:         1201   21,    1210   01,    1211   21,    1200 01,    -1212   01,
                   -1211  -21,    1221   21

Main Line 8: S2     1220   02
Side Bands:         1201   22

Main Line 9: Sa     1001  -12,   -1001   12
Side Bands:        -1020  -12

Main Line 10: Mtm  -1020   11
Side Bands:         1001  -31,   -1010   11,    1002  -11

Main Line 11: Q1    1120   11
Side Bands:         1100   11,    1110   11,    1101   31

Main Line 12: M1    1101   11,   -1101  -11
Side Bands:         1110  -11,    1120  -11,   -1111  -11,    1111   11,    1121   11

Main Line 13: J1    1101  -11,   -1101   11
Side Bands:        -1111   11,    1111  -11,    1121  -11,   -1120  -11,   -1110  -11

Main Line 14: OO1  -1120   01
Side Bands:         1101  -21,    1111  -21,   -1110   01,    1102   01,    1112   01

Main Line 15: 2N2   1220   21
Side Bands:         1210   21

Main Line 16: N2    1220   11
Side Bands:         1210   11

Main Line 17: L2    1220  -11
Side Bands:         1210  -11,   -1211  -11,    1201   11,    1211   11,    1221 11

Main Line 18: K2    1201   01,   -1201   01,    1201   02,   -1201   02,    1201   00
Side Bands:        -1211   01,    1211   01,    1221   01
```

```
UNITS:   KM =Kilometers; M  =Meters     ; S =Seconds    ; Kg =Kilograms
         DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds



IF CARD OMITTED: The expanded ocean tide model is not used. See TIDES card for
                 tide model theat will be used.
```

2.3.73 OTIDES

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OTIDES+1   2 2 +1220 011 -.0224744         +.0192629      10.          10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OTIDES - Requests application and/or adjustment of ocean tides. There are two Ocean Tide models available in GEODYN. First implemented was the Colombo tide model and unnormalized Legendre polynomials. M and K symmetry is NOT included. The presence of a RAYTID option before the OTIDES cards invoques the Doodson Ocean Tides. Immediately following there is a description of the Colombo model. At the end of this page there will be a descrption of the Doodson model.	Colombo Model
7-8	I2	Indicates sign (+ or -) term in harmonic expansion, for prograde or retrograde	+1
9	I1	Indicates form of input coefficients. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients. [NOTE 1]	0
11-12	I2	Degree of expansion.	0
13-14	I2	Order of expansion.	0
15-17	I3	Sign (+1 or -1) of the Demos Number. [NOTE 2] This sign multiplies the quantity $-((2 - H) * \omega + (2 - 2H + J) * M + K * Omega)$	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0
23	I1	Indicates form of tidal amplitude coefficient [$V_f(t)$ / $\bar{V}_f$] [NOTE 3] 0 = only main line, fixed coefficient	0

```
                  1 = main line and sidebands , variable
                      coefficient
                  2 = only main line , variable coefficient

24      I1      Disturbing Body (B). [NOTE 2]                          0

                  0 = Moon and Sun
                  1 = Moon
                  2 = Sun

25-44   D20.8   "A" coefficient. [NOTE 1]                             0.    M

45-59   D15.3   "B" coefficient. [NOTE 1]                             0.    M

60-72   D13.1   Sigma "A".                                            0.    M

73-80   D8.2    Sigma "B".                                            0.    M


NOTES :

 [1]    The "A" and "B" coefficients are related to amplitude and phase
        by the following formulas :

            A =   amplitude * cos (phase)
            B = -amplitude * sin (phase)

 [2]    The "Demos Number" is represented in the Parameter Label (Word #2)
        as follows :

        *************************************************************
        *    SIGN OF    *                              *   SIGN OF   *
        *    HARMONIC   *     MKH*1000+(J+10)*10+B      *   DEMOS     *
        *    EXPANSION  *                              *   NUMBER    *
        *************************************************************

 [3]    There are 30 recognized main tidal lines.
        Their Demos numbers are :

        SMKH   JB                            SMKH   JB   (See page 1 for S M K H
                                                          J B definitions)
        -1020  02                            -1020  11
         1001  -11                            1120  11
        -1001  11                             1101  11
        -1020  01                            -1101 -11
         1120  01                             1101 -11
         1120  02                            -1101  11
         1101  01                            -1120  01
        -1101  01                             1220  21
         1101  02                             1220  11
        -1101  02                             1220 -11
         1101  00                             1201  01
         1220  01                            -1201  01
         1220  02                             1201  02
         1001 -12                            -1201  02
        -1001  12                             1201  00


                                  131
```

Of these 30 main lines there are 18 distinct frequencies. The side bands
associated with these 18 main line frequencies are:

```
Main Line 1: Ssa   -1020   02
Side Bands:         1001  -22

Main Line 2: Mm     1001  -11,   -1001   11
Side Bands:        -1021   11,   -1011   11,    1011  -11,    1021  -11,
                   -1020  -11,   -1010  -11,    1002   11,    1012   11

Main Line 3: Mf    -1020   01
Side Bands:        -1021   21,   -1011   21,    1001  -21,    1011  -21,
                    1021  -21,   -1010   01,   -1000   01,    1012   01

Main Line 4: O1     1120   01
Side Bands:        -1112   01,    1100   01,    1110   01,   -1111  -21,
                    1101   21,    1111   21,    1121   21

Main Line 5: P1     1120   02
Side Bands:         1101   22

Main Line 6: K1     1101   01,   -1101   01,    1101   02,   -1101   02,    1101   00
Side Bands:        -1121   01,   -1111   01,    1111   01,    1121   01

Main Line 7: M2     1220   01
Side Bands:         1201   21,    1210   01,    1211   21,    1200  01,    -1212   01,
                   -1211  -21,    1221   21

Main Line 8: S2     1220   02
Side Bands:         1201   22

Main Line 9: Sa     1001  -12,   -1001   12
Side Bands:        -1020  -12

Main Line 10: Mtm  -1020   11
Side Bands:         1001  -31,   -1010   11,    1002  -11

Main Line 11: Q1    1120   11
Side Bands:         1100   11,    1110   11,    1101   31

Main Line 12: M1    1101   11,   -1101  -11
Side Bands:         1110  -11,    1120  -11,   -1111  -11,    1111   11,    1121   11

Main Line 13: J1    1101  -11,   -1101   11
Side Bands:        -1111   11,    1111  -11,    1121  -11,   -1120  -11,   -1110  -11

Main Line 14: O01  -1120   01
Side Bands:         1101  -21,    1111  -21,   -1110   01,    1102   01,    1112   01

Main Line 15: 2N2   1220   21
Side Bands:         1210   21

Main Line 16: N2    1220   11
Side Bands:         1210   11

Main Line 17: L2    1220  -11
Side Bands:         1210  -11,   -1211  -11,    1201   11,    1211   11,    1221   11
```

```
Main Line 18: K2    1201  01,   -1201  01,    1201  02,   -1201  02,    1201  00
Side Bands:          -1211  01,    1211  01,    1221  01
```

[4]

This document contains the complete list of GEODYN OTIDE cards. If a Doodson
number does not appear on the printed tables, then GEODYN cannot model the tide
associated with that Doodson number.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The ocean tide model is not used.

                          OCEAN TIDE MODELING

Ocean tide modeling in GEODYN is accomplished using the OTIDES option.
The following explanation will assist the user in invoking specific
tides and describes in more detail the implementation of the "tidal
families" within GEODYN. The ocean tidal constituents are divided
into two categories: Those major tides which (a) do and those which
(b) do not have significant sideband constituents. The sidebands are
long period modulations within a narrow band of the main tide lines.
For the 18 tide lines identified by GEODYN as having significant
sidebands, under the assumption that the admittances can be treated
as identical for near-by frequencies, GEODYN used linear admittances
to provide for the sideband tides within these so-called "tidal
families" if requested. When column 23 is set to 1 on the OTIDES card,
every degree and order element specified for the mainline tide causes
inclusion of the same harmonic for all of the corresponding sideband
tide lines in both the surface height and force modeling calculations.
However, if the tide line is not recognized by GEODYN as having
significant sideband contributions, a 1 in column 23 will be ignored.
Since the linear admittances are computed using the ratio of the
Doodson coefficients of the sidebands with respect to the mainline,
the Doodson ceofficients shown in the following tables indicate the
relative importance of the sideband terms within the total tidal
family.
    The following tables describe the ocean tidal constituents
available within GEODYN. Tables 1, 1.1, 1.2, and 1.3 present
tidal constituents which have no internal tables containing sideband
terms. Therefore, even if the option flag in column 23 is set
to 1, no sideband modeling will be invoked. Table 2. lists the most
important tides commonly used in orbit modeling which fall within this
category. Tables 3, 3.1, 3.2 and 3.3 present the 18 tidal families
which can be invoked using the "family option" (column 23 set equal to
1 on the OTIDES card). Shown within these tables is the mainline tide,
the default sidebands which are included, and the terms in the angular
arguments defining the tide which modulate the mainline angular
argument.

    1. TIDES TREATED AS MAINLINE CONSTITUENTS:
  NOTE: THESE TIDES HAVE NO PRE-DEFINED SIDEBAND CONSTITUENTS

1.1. LONG PERIOD BAND

DOODSONS NUMBER	EARTH PERIOD (D=DAY,H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	
058.5525	121.7532D	0.000007	1001-32	
058.5545	121.7493D	0.004262	1020 12	
059.5535	91.3127D	0.000173	1020 22	
05X.5525	73.0505D	0.000006	1020 32	
095.1455	6.8956D	-0.000003	1011 41	
095.1555	6.8886D	0.000044	1001-41	
095.1655	6.8817D	-0.000003	1011-41	
095.3555	6.8594D	0.004014	1020 21	
095.3655	6.8525D	0.001663	1010 21	
095.3755	6.8456D	0.000156	1000 21	
095.3855	6.8387D	-0.000003	1012-21	
0X5.2555	5.4922D	0.000456	1020 31	
0X5.2655	5.4877D	0.000189	1010 31	
0X5.2755	5.4833D	0.000018	1000 31	
0E5.1555	4.5794D	0.000047	1020 41	
0E5.1655	4.5763D	0.000020	1010 41	
0E5.1755	4.5732D	0.000002	1000 41	

1.2 DIURNAL BAND

DOODSONS NUMBER	EARTH PERIOD (D=DAY,H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	
105.9455	1.2751D	0.000022	1110 41	
105.9555	1.2749D	0.000114	1120 41	
115.8355	1.2190D	-0.000006	1100 31	
115.8455	1.2187D	0.000207	1110 31	
115.8555	1.2185D	0.001099	1120 31	
125.7355	1.1673D	-0.000056	1100 21	
125.7455	1.1671D	0.001823	1110 21	
125.7555	1.1669D	0.009669	1120 21	2Q1
125.9555	1.1661D	-0.000016	1101 41	
125.9655	1.1659D	-0.000003	1111 41	
155.4355	1.0357D	0.000060	1100-11	
155.4455	1.0355D	-0.001965	1110-11	
155.4555	1.0354D	-0.010427	1120-11	
155.6355	1.0350D	-0.000005	-1121-11	
155.6455	1.0349D	0.000864	-1111-11	
155.6555	1.0347D	-0.029805	1101 11	
155.6655	1.0346D	-0.005907	1111 11	
155.6755	1.0344D	0.000127	1121 11	
160.5585	1.0111D	0.000014	1120 32	
161.5575	1.0083D	0.000418	1120 22	
162.5565	1.0055D	0.010266	1120 12	π_1
162.5585	1.0055D	-0.000003	1101 32	
164.5545	1.0000D	-0.001467	1120-12	
164.5565 2	4.0000H	-0.004214	1101 12	S_1
166.5545 2	3.8693H	-0.004214	1101-12	ψ_1
166.5565 2	3.8693H	0.000063	-1120-12	
167.5535 2	3.8045H	-0.000106	1101-22	

```
167.5555 2   3.8045H   -0.007544  -1120 02      φ₁
167.5556 2   3.8045H   -0.000002  -1110 02
168.5525 2   3.7400H   -0.000003   1101-32
168.5545 2   3.7400H   -0.000442   1120 12
169.5535 2   3.6759H   -0.000018  -1120 22
175.2555 2   3.1122H    0.000001   1120-31
175.4355 2   3.1050H   -0.000005  -1121 11
175.4455 2   3.1017H    0.000864  -1111 11
175.4555 2   3.0985H   -0.029805   1101-11      J₁
175.4655 2   3.0952H   -0.005907   1111-11
175.4755 2   3.0919H    0.000127   1121-11
175.6555 2   3.0847H    0.000449   1120-11
175.6655 2   3.0815H    0.000288  -1110-11
175.6755 2   3.0782H    0.000060   1102 11
175.6855 2   3.0749H    0.000004   1112 11
195.2455 2   1.5931H    0.000006  -1111 31
195.2555 2   1.5903H   -0.000198   1101-31
195.2655 2   1.5874H   -0.000039   1111-31
195.4555 2   1.5782H   -0.003125  -1120 11
195.4655 2   1.5754H   -0.002000  -1110 11
195.4755 2   1.5725H   -0.000420   1102-11
195.4855 2   1.5697H   -0.000028   1112-11
1X5.1555 2   0.9077H   -0.000016   1101-41
1X5.1655 2   0.9050H   -0.000003   1111-41
1X5.3555 2   0.8964H   -0.000417  -1120 21
1X5.3655 2   0.8937H   -0.000267  -1110 21
1X5.3755 2   0.8910H   -0.000056   1102-21
1X5.3855 2   0.8884H   -0.000004   1112-21
1E5.2555 2   0.2563H   -0.000047  -1120 31
1E5.2655 2   0.2538H   -0.000030  -1110 31
1E5.2755 2   0.2513H   -0.000006   1102-31
1F5.1555    19.6543H  -00.0000005-1120 41
1F5.1655    19.6519H  -00.000003  -1110 41
```

1.3   SEMI-DIURNAL BAND

DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	
215. 9455	13. 4306H	- 0.000010	1210 41	
215. 9555	13. 4295H	0.000275	1220 41	
225. 8355	13. 1644H	0.000001	1200 31	
225. 8455	13. 1633H	- 0.000099	1210 31	
225. 8555	13. 1622H	0.002647	1220 31	
235. 7555	12. 9054H	0.023293	1220 21	$2N2$
270. 5585	12. 0495H	0.000035	1220 32	
271. 5575	12. 0329H	0.001006	1220 22	
274. 5545	11. 9836H	- 0.003535	1220-12	R_2
274. 5565	11. 9836H	0.000914	1201 12	
276. 5545	11. 9509H	0.000914	1201-12	
276. 5565	11. 9509H	- 0.000007	- 1220-12	
277. 5535	11. 9346H	0.000023	1201-22	
277. 5555	11. 9346H	0.000783	- 1220 02	
278. 5545	11. 9184H	0.000046	- 1220 12	
279. 5535	11. 9022H	0.000002	- 1220 22	
285. 2555	11. 7581H	0.000003	1220-31	
285. 4455	11. 7554H	- 0.000121	- 1211 11	

285.	4555	11.	7545H		0.006465		1201	-11	η_2
285.	4655	11.	7537H		0.002816		1211	-11	
285.	4755	11.	7528H		0.000305		1221	-11	
285.	6555	11.	7510H	-	0.000047	-	1220	-11	
285.	6655	11.	7501H	-	0.000040	-	1210	-11	
285.	6755	11.	7493H	-	0.000013		1202	11	
285.	6855	11.	7484H	-	0.000002		1212	11	
295.	3455	11.	5501H	-	0.000010	-	1211	21	
295.	3555	11.	5492H		0.000532		1201	-21	
295.	3655	11.	5484H		0.000232		1211	-21	
295.	3755	11.	5476H		0.000025		1221	-21	
295.	5555	11.	5458H		0.001686	-	1220	01	
295.	5655	11.	5450H		0.001460	-	1210	01	
295.	5755	11.	5442H		0.000474		1202	01	
295.	5855	11.	5433H		0.000068		1212	01	
295.	5955	11.	5425H		0.000004		1222	01	
2X5.	2555	11.	3510H		0.000043		1201	-31	
2X5.	2655	11.	3502H		0.000019		1211	-31	
2X5.	2755	11.	3494H		0.000002		1221	-31	
2X5.	4555	11.	3477H		0.000324		-1220	11	
2X5.	4655	11.	3469H		0.000281		-1210	11	
2X5.	4755	11.	3461H		0.000091		1202	-11	
2X5.	4855	11.	3453H		0.000013		1212	-11	
2E5.	1555	11.	1595H		0.000003		1201	-41	
2E5.	1655	11.	1587H		0.000001		1211	-41	
2E5.	3555	11.	1562H		0.000043		-1220	21	
2E5.	3655	11.	1555H		0.000037		-1210	21	
2E5.	3755	11.	1547H		0.000012		1202	-21	
2E5.	3855	11.	1540H		0.000002		1212	-21	
2F5.	2555	10.	9712H		0.000005		-1220	31	
2F5.	2655	10.	9704H		0.000004		-1210	31	
2F5.	2755	10.	9697H		0.000001		1202	-31	

2. IMPORTANT TIDES TREATED AS MAINLINE CONSTITUENTS:
   NOTE: THESE TIDES HAVE NO PRE-DEFINED SIDEBAND CONSTITUENTS

TIDE	DOODSONS NUMBER	EARTH PERIOD (Y=YEAR,H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA
18.6 YR LUN	055.5655	18.8712Y	-0.065520	1011 01	0	0	1	0
9.4 YR LUN	055.5755	9.4356Y	0.000640	1021 01	0	0	2	0
T2 SOLAR	272.5565	12.0164H	0.024729	1220 12	2	3	2	2

3. TIDES WHICH CAN BE MODELED AS FAMILIES:
   NOTE: THESE TIDES HAVE PRE-DEFINED SIDEBAND CONSTITUENTS

3.1 LONG PERIOD BAND

		SA FAMILY				SUN		
	DOODSONS NUMBER	EARTH PERIOD (D=DAY,Y=YEAR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA
MAINLINE	056.5545	1.0139Y	0.011733	1001 -12	0	1	0	0
SIDEBAND	056.5565	1.0138Y	-0.000609	-1020 -12	2	1	2	0

```
                    SSA    FAMILY                                    SUN
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     057.5555    182.6211D    0.072687   -1020 02    2      2      2      0

     SIDEBAND     057.5535    182.6298D    0.000295    1001-22    0      2      0      0


                    MM     FAMILY                                    MOON
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     065.4555     27.5546D    0.082984    1001-11    0      1      0      0

     SIDEBAND     065.4355     27.7797D    0.000053   -1021 11    0      1      2      0
     SIDEBAND     065.4455     27.6667D   -0.005390   -1011 11    0      1      1      0
     SIDEBAND     065.4655     27.4433D   -0.005390    1011-11    0      1     -1      0
     SIDEBAND     065.4755     27.3330D    0.000053    1021-11    0      1     -2      0
     SIDEBAND     065.6555     27.0925D   -0.004329   -1020-11    2      1      2      0
     SIDEBAND     065.6655     26.9850D   -0.001793   -1010-11    2      1      1      0
     SIDEBAND     065.6755     26.8783D   -0.000168    1002 11    2      1      0      0
     SIDEBAND     065.6855     26.7724D    0.000004    1012 11    2      1     -1      0


                    MF     FAMILY                                    MOON
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     075.5555     13.6608D    0.156567   -1020 01    2      2      2      0

     SIDEBAND     075.3355     13.8333D    0.000004   -1021 21    0      2      2      0
     SIDEBAND     075.3455     13.8053D   -0.000443   -1011 21    0      2      1      0
     SIDEBAND     075.3555     13.7773D    0.006827    1001-21    0      2      0      0
     SIDEBAND     075.3655     13.7494D   -0.000443    1011-21    0      2     -1      0
     SIDEBAND     075.3755     13.7217D    0.000004    1021-21    0      2     -2      0
     SIDEBAND     075.5655     13.6334D    0.064864   -1010 01    2      2      1      0
     SIDEBAND     075.5755     13.6061D    0.006086   -1000 01    2      2      0      0
     SIDEBAND     075.5855     13.5789D   -0.000131    1012 01    2      2     -1      0


                    MTM    FAMILY                                    MOON
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     085.4555      9.1329D    0.030112   -1020 11    2      3      2      0

     SIDEBAND     085.2555      9.1849D    0.000551    1001-31    0      3      0      0
     SIDEBAND     085.4655      9.1207D    0.012475   -1010 11    2      3      1      0
     SIDEBAND     085.4755      9.1085D    0.001171    1002-11    2      3      0      0

3.2 DIURNAL BAND

                    Q1     FAMILY                                    MOON
               DOODSONS     EARTH      DOODSONS    GEODYN
                NUMBER      PERIOD     COEFFIC.    +MKH JB
                        (D=DAY,H=HOUR)             ARGUMENT
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     135.6555      1.1195D    0.072536    1120 11   -2     -3     -2      1

     SIDEBAND     135.6355      1.1199D   -0.000420    1100 11   -2     -3      0      1
     SIDEBAND     135.6455      1.1197D    0.013673    1110 11   -2     -3     -1      1
     SIDEBAND     135.8555      1.1187D   -0.000198    1101 31    0     -3      0      1


                    O1     FAMILY                                    MOON
                                                        OMEG   MEAN   NODE   THETA
     MAINLINE     145.5555      1.0758D    0.377150    1120 01   -2     -2     -2      1
```

						OMEG	MEAN	NODE	THETA
SIDEBAND	145.5255	1.0763D	0.000021	-1112	01	-2	-2	1	1
SIDEBAND	145.5355	1.0761D	-0.002186	1100	01	-2	-2	0	1
SIDEBAND	145.5455	1.0760D	0.071090	1110	01	-2	-2	-1	1
SIDEBAND	145.7455	1.0753D	0.000071	-1111	-21	0	-2	1	1
SIDEBAND	145.7555	1.0751D	-0.002452	1101	21	0	-2	0	1
SIDEBAND	145.7655	1.0749D	-0.000486	1111	21	0	-2	-1	1
SIDEBAND	145.7755	1.0748D	0.000010	1121	21	0	-2	-2	1

	M1 FAMILY				MOON				
						OMEG	MEAN	NODE	THETA
MAINLINE	155.6555	1.0347D	-0.029805	1101	11	0	-1	0	1
SIDEBAND	155.4455	1.0355D	-0.001965	1110	-11	-2	-1	-1	1
SIDEBAND	155.4555	1.0354D	-0.010427	1120	-11	-2	-1	-2	1
SIDEBAND	155.6455	1.0349D	0.000864	-1111	-11	0	-1	1	1
SIDEBAND	155.6655	1.0346D	-0.005907	1111	11	0	-1	-1	1
SIDEBAND	155.6755	1.0344D	0.000127	1121	11	0	-1	-2	1

	P1 FAMILY				SUN				
						OMEG	MEAN	NODE	THETA
MAINLINE	163.5555	1.0027D	0.175093	1120	02	-2	-2	-2	1
SIDEBAND	163.5575	1.0027D	-0.000106	1101	22	0	-2	0	1

	K1 FAMILY				SUN/MOON				
						OMEG	MEAN	NODE	THETA
MAINLINE	165.5555	23.9345H	-0.530078	1101	01	0	0	0	1
SIDEBAND	165.5355	23.9415H	-0.000066	-1121	01	0	0	2	1
SIDEBAND	165.5455	23.9380H	0.010506	-1111	01	0	0	1	1
SIDEBAND	165.5655	23.9310H	-0.071809	1111	01	0	0	-1	1
SIDEBAND	165.5755	23.9274H	0.001541	1121	01	0	0	-2	1

	J1 FAMILY				MOON				
						OMEG	MEAN	NODE	THETA
MAINLINE	175.4555	23.0985H	-0.029805	1101	-11	0	1	0	1
SIDEBAND	175.4455	23.1017H	0.000864	-1111	11	0	1	1	1
SIDEBAND	175.4655	23.0952H	-0.005907	1111	-11	0	1	-1	1
SIDEBAND	175.4755	23.0919H	0.000127	1121	-11	0	1	-2	1
SIDEBAND	175.6555	23.0847H	0.000449	-1120	-11	2	1	2	1
SIDEBAND	175.6655	23.0815H	0.000288	-1110	-11	2	1	1	1

	OO1 FAMILY				MOON				
						OMEG	MEAN	NODE	THETA
MAINLINE	185.5555	22.3061H	-0.016249	-1120	01	2	2	2	1
SIDEBAND	185.3555	22.3189H	-0.002452	1101	-21	0	2	0	1
SIDEBAND	185.3655	22.3159H	-0.000486	1111	-21	0	2	-1	1
SIDEBAND	185.5655	22.3030H	-0.010401	-1110	01	2	2	1	1
SIDEBAND	185.5755	22.3000H	-0.002186	1102	01	2	2	0	1
SIDEBAND	185.5855	22.2969H	-0.000144	1112	01	2	2	-1	1

3.3 SEMI-DIURNAL BAND

2N2 FAMILY   MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	235.7555	12.9054H	0.023293	1220	21	-2	-4	-2	2
SIDEBAND	235.7455	12.9064H	-0.000869	1210	21	-2	-4	-1	2

N2   FAMILY   MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	245.6555	12.6583H	0.174731	1220	11	-2	-3	-2	2
SIDEBAND	245.6455	12.6593H	-0.006518	1210	11	-2	-3	-1	2

M2   FAMILY   MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	255.5555	12.4206H	0.908507	1220	01	-2	-2	-2	2
SIDEBAND	255.5255	12.4234H	-0.000003	-1212	01	-2	-2	1	2
SIDEBAND	255.5355	12.4225H	0.000474	1200	01	-2	-2	0	2
SIDEBAND	255.5455	12.4215H	-0.033892	1210	01	-2	-2	-1	2
SIDEBAND	255.7455	12.4176H	-0.000010	-1211	-21	0	-2	1	2
SIDEBAND	255.7555	12.4166H	0.000532	1201	21	0	-2	0	2
SIDEBAND	255.7655	12.4157H	0.000232	1211	21	0	-2	-1	2
SIDEBAND	255.7755	12.4147H	0.000025	1221	21	0	-2	-2	2

L2   FAMILY   MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	265.4555	12.1916H	-0.025118	1220	-11	-2	-1	-2	2
SIDEBAND	265.4455	12.1925H	0.000937	1210	-11	-2	-1	-1	2
SIDEBAND	265.6455	12.1887H	-0.000121	-1211	-11	0	-1	1	2
SIDEBAND	265.6555	12.1878H	0.006465	1201	11	0	-1	0	2
SIDEBAND	265.6655	12.1869H	0.002816	1211	11	0	-1	-1	2
SIDEBAND	265.6755	12.1860H	0.000305	1221	11	0	-1	-2	2

S2   FAMILY   SUN

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	273.5555	12.0000H	0.421776	1220	02	-2	-2	-2	2
SIDEBAND	273.5575	12.0000H	0.000023	1201	22	0	-2	0	2

K2   FAMILY   SUN/MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT		OMEG	MEAN	NODE	THETA
MAINLINE	275.5555	11.9672H	0.114980	1201	01	0	0	0	2
SIDEBAND	275.5455	11.9681H	-0.001475	-1211	01	0	0	1	2
SIDEBAND	275.5655	11.9664H	0.034235	1211	01	0	0	-1	2
SIDEBAND	275.5755	11.9655H	0.003713	1221	01	0	0	-2	2

DOODSON OCEAN TIDE MODEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OTIDES
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                       DEFAULT VALUE & UNITS

1-6     A6     OTIDES - Requests application and/or
```

adjustment of Doodson ocean tides .   Colombo Ocean Tides

7-8   I2   Indicates sign term of the expansion:
          +1 = prograde tide
             -1 = retrograde tide

9   I1   Forcing degree in tide operating potential
                 (2 or 3). The order is the first integer in
          the Doodson number given in columns 18-24.

10   I1   Integer number [0,...,3] gives phase increment
          after x{pi/2}. Useful when all tides use cosine
          factors with positive amplitudes.

11-12   I2   Response degree of A,B coefficients.

13-14   I2   Response order of A,B coefficients.

15   I1   Paramater type index
          =0 Ocean tide coefficient
                 =1 Atmospheric Tide coefficient

16-17   I2   Integer Flag:

                 =0 no sidelines
                 =1 turn n sidelines with input
                    tidal constituent.
                 =2 turn n sidelines with input
                    tidal group.

18-24   I7   Doodson Number (six positive integers)

25-44   D20.8   "A" coefficient.   0.   M

45-59   D15.3   "B" coefficient.   0.   M

60-72   D13.1   Sigma "A".   0.   M

73-80   D8.2   Sigma "B".   0.   M

2.3.74 OTMOD

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
OTMOD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   Introduces the application/estimation
                 of ocean tide model which employs
                 Proudman functions evaluated at several
                 points located on a uniform grid on the
                 globe. The tidal height at a given
                 location is evaluated by interpolation
                 and it represents the tidal effect
                 measured from the mean sea surface.

NOTE [1]: This card must be followed by a number of OTCOEF cards
           which represent the total number of Proudman functions.

IF CARD OMITTED: The above described tide model will not be applied.

2.3.75 PARFIL

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+---8
PARFIL   7375                                                         20000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests output of measurement partial derivative file(s) on last inner iteration of each data reduction arc during first global iteration.	
7	I1	Indicates whether each arc should open a new logical unit for output or continue writing to the same unit as the previous arc.	0
		0 - Concatenate all arcs providing header information between each arc.	
		1 - CLOSE currently open output file at end of each arc and increment output unit number for start of each new arc.	
		2 - ENDFILE currently open output file at end of each arc. (applies only to IBM type operating environment for GEODYN-IIE)	
11-12	I2	Indicates logical unit number (NU1) of first segment of file. Maximum segment size is specified in columns 73-80. NOTE: 90 .LE. NU1 .LE. 99	90
		If segment size is exceeded, the currently open logical unit will be CLOSED, the unit number will be incremented by one and output will continue.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
11-12 cont.		If column 7 contains a one, then the currently open logical unit will be CLOSEd at the end of each arc, the unit number will be incremented by one and output will continue for the next arc.	
		If column 7 contains a two, then the currently open logical unit will be ENDFILEd at the end of each arc, the unit number will remain the same, and output will continue for the next arc.	
13-14	I2	Maximum unit number (NU2) that will be opened for output of this partial derivative file.	Same as cols. 11-12

```
                NOTE: NU1 .LE. NU2 .LE. 99


25-44  D20.8   Partial derivative file number to uniquely      E-Matrix Number
               identify the file.                              or 0. if no EMAT


73-80   F8.1   Number of blocks (of 512 64-bit words)             20000.
               of disk space requested for each segment of
               the measurement partial derivative file.

               A good estimate for the total disk space
               required for the entire measurement partial
               derivative file may be obtained by multiplying
               the number of weighted observations by the
               number of adjusted parameters and dividing
               by 512.

               If outputing to tape, specification of a very
               large number here will prevent incrementing
               of unit number unless specified by column 7.


IF CARD OMITTED: No measurement partial derivative file will be generated.
```

2.3.76 PLANET

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLANET     300 20 20          3.986004359D+14 6378144.11    298.255
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLANET - Modifies the 3rd body gravitational potential and/or introduces new constants.	
7	I1	Gravity model initalization indicator.	0
		= 0 Gravitational coefficients are initialized from gravity model file. They may be changed by GCOEF, GCOEFC or GCOEFS cards.	
		> 0 Gravitational coefficients are set to zero except those which appear on GCOEF, GCOEFC, or GCOEFS cards which follow this card.	
8	I1	Gravity model print control switch.	0
		= 0 Print two portions of model: 1. lowest degree & order; and 2. highest degree & order.	
		= 1 Print entire gravity model. :	
		= 2 Print only model checksum. :	: N/A
9	I1	Indicator of the contents of the remainder of this card:	0
		= 0 Columns 25-80 contain the values for GMb, Ab, 1/fp, 1/fe.	
		= 1 Columns 25-80 contain the (see NOTE[3]) sigmas for GMb, Ab, 1/fp, 1/fe.	
10	I1	> 0 Indicates that this body should be excluded from force model calculations	
11-14	I4	Indicates body for which gravity perturbation is to be modified.	no default
		Body numbers are as follows:	
		0100 Mercury	
		0200 Venus	
		0300 Earth	
		0301 Earth's Moon	
		0400 Mars	
		0500 Jupiter	

```
                        0600    Saturn
                        0700    Uranus
                        0800    Neptune
                        0900    Pluto
                        9999    Sun


15-17    I3      Maximum degree of coefficient to be              3
                 used in the gravitational model.
                 Minimum =3.  Default depends on gravity
                 model file on unit 12.(See NOTE[1] and
                 NOTE[2]).


18-20    I3      Maximum order of coefficient to be               2
                 used in the gravitational model.
                 Minimum =2.  Default depends on
                 gravity model file on unit 12.
                 (See NOTE[2]).

                 The presence of degree and order in the
                 two integer fields above automatically
                 defines this planet as the center of
                 integration


21-22    I2      Precession model indicator for
                 Mars orbiters.
                 =0 The old precession model is used        old model
                 =1 The new precession nutation model
                  is used


23       I1      Index to planetary constant option        1989 Planetary
                 =0 1989 planetary constants for Venus      constants for Venus
                 =1 1991 planetary constants for Venus
                 =2 2000 planetary constants for Venus
               =4 2000 IAU constants for Mars               1991 Mars IAU const.
               =5 The Mars orientation model
            Konopliv-Yoder will be used
                 =6 2011 Margot Model for Mercury           2011 Margot Model
                 =7 IAU2000 for Mercury


24       I1      Index to lunar orientation parameter       COSPAR report
                 option
                 =0 values from the report /IAU/IAG/COSPAR
                 =1 values drom the 403 Planetary Ephemeris


25-44    D20.8   Universal gravitational constant           See table below for
                 times the mass of the Body (GMb),          third body perturb.
                 or sigma value if column 9 =1,               (M**3/S**2)


45-59    D15.3   Semi-major axis of the Body (Ab),          See table below for
                 or sigma value if column 9 =1,             third body perturb.
                                                                   (M)


60-72    D13.1   Inverse of the Body's polar                See table below for
                 flattening (1/fp),                         third body perturb.
                 or sigma value if column 9 =1,


73-80    D8.3    Inverse of the Body's equatorial flattening    0.
                 (1/fe) or sigma value if column 9 =1.
```

```
                    TABLE OF DEFAULT BODY CONSTANTS


 Body           GMb             Ab              fp              fe
 ------------- --------------- --------------- --------------- ---------------


 Mercury        2.203208000D+14
 Venus          3.248602000D+14 6.168810000D+06 0.0             0.0
 Earth's Moon   4.902778000D+12 1.738090000D+06 0.378000000D-03 0.0
 Mars           4.282845000D+13 3.380422000D+06 0.105000000D-01 0.0
 Jupiter        1.267077000D+17 7.137155400D+07 0.667000000D-01 0.0
 Saturn         3.792653500D+16 6.041128000D+07 0.105000000D 00 0.0
 Uranus         5.780158500D+15
 Neptune        6.871307800D+15
 Pluto
 Sun            1.327125000D+20 6.960000000D+08 0.500000000D-04 0.0

NOTE[1]:
        The default values for degree and order of the gravity field and
        the Body constants are overridden by the values from the gravity
        model file on unit 12.

        EARTH and PLANET are actually the same keyword card except that
        EARTH automatically supplies the planet number (0300).

NOTE[2]:
        All interplanetary runs need PLANET cards for Saturn and Jupiter
        for the relativity modelling.

NOTE[3]:
        Only one set of (GMb,Ab,1/fp,1/fe) parameters can be adjusted.
        This set of parameters must be for the central body.

UNITS:  M  =Meters    ; S  =Seconds


IF CARD OMITTED:
        The complete gravitational field contained in the default gravity
        model file on unit 12 will be used for the central body and the sun
        and moon will be used as third body perturbers. If the central body
        is other than Earth, then Earth will replace that body as a third
        body pertubation.
```

2.3.77 PLANOR

*** NOTE ***

The documentation below is for the latest version of GEODYN (version 1501 and later).
Earlier versions have a different setup for applying the PLANOR option.

If using GEODYN version 1410, see PLANOR_1410.

If using GEODYN version 1404 or earlier, see PLANOR_1312_AND_EARLIER.

****

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLANOR
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                              DEFAULT VALUE & UNITS

1-6      A6       PLANOR - Introduces modification and/or
                  estimation of planetary orientation parameters.

                  The planetary orientation parameters are used
                  to describe the orientation of the central body
                  at any epoch. The orientation of the body is
                  given by three angles: the right ascension (RA)
                  and declination (DEC) of the pole (with respect
                  to the J2000 Earth equator and equinox coordinate
                  system) and the W angle between the prime meridian
                  of the body and the body's inertial IAU vector
                  (the RA and DEC of the pole determine the inertial
                  location of the IAU vector).

                  For the sun, the moon and the 9 major planets,
                  GEODYN has default models for orientation. The
                  PLANOR option allows the user to build a user
                  defined planetary orientation model to repalce a
                  default model or to define the orientation of a
                  body not included on the DEXXX ephemeris. In
                  versions prior to 1501 the user defined model is
                  analytical with linear terms in RA and DEC. For W
                  a quadratic model with an arbitrary number of
                  periodic terms is possible.

                  Starting with version 1501 many upgrades have been
                  made to the PLANOR capability. There are two types
                  of models avaiable, analytical and dynamic. In
                  analytical mode the RA and DEC now have periodic
                  terms in addition to the linear terms. The
                  analytical model may have an aribitrary number of
                  periods. For each period there will be an Acos and
                  Bsin parameter for each of the three angles, RA,
                  DEC and W. The linear and quadratic terms must be
                  referenced to a base epoch and this is the J2000
                  epoch (12 HR Jan 1, 2000, ET).


                  Also starting with the 1501 version the user may
                  request a dynamic orientation model. The dynamic
```

orientation model is used when there is a "1" in column 7 of the INTGCB card. So, the dynamic orientation model is available only when the orbit of the central body is being numerically integrated. In dynamic mode there are 12 parameters. These are the three angles (RA, DEC and W) at the initial epoch of the arc, the derivatives wrt time of the three angles at the initial epoch of the arc and 6 moments of inertia of the central body with respect to the body fixed cartesian axes. In this mode the orientation of the axes is numerically integrated from the initial state at the initial arc epoch. The step size of the integration is the same as that chosen for the central body orbit numerical integration.

Just below is a list of all of the parameters available (some apply only to analytical mode or only to dynamic mode, for the units see NOTE 2):

α = right ascension
    (analytical and dynamic mode)

dα/dt = right ascension rate
    (analytical and dynamic mode)

δ = declination
    (analytical and dynamic mode)

dδ/dt = declination rate
    (analytical and dynamic mode)

W = prime meridian
    (analytical and dynamic mode)

dW/dt = prime meridian rate
    (analytical and dynamic mode)

d2W/dt2 = prime meridian acceleration
    (analytical mode only)

Ai = Coefficient to cosωti term for Right Ascension.
    (analytical mode only, 1501 version and later)

Bi = Coefficient to sinωti term for Right Ascension.
    (analytical mode only, 1501 version and later)

Ci = Coefficient to cosωti term for Declination.
    (analytical mode only, 1501 version and later)

Di = Coefficient to sinωti term for Declination.
    (analytical mode only, 1501 version and later)

Ei = Coefficient to cosωti term for Rotation.
    (analytical mode only)

Fi = Coefficient to sinωti term for Rotation.

```
                   (analytical mode only)

              i = 1, # of periodic terms


         Ixx = Moment of inertia about X axis
               (dynamic mode only)

         Iyy = Moment of inertia about Y axis
               (dynamic mode only)

         Izz = Moment of inertia about Z axis
               (dynamic mode only)

         Ixy = XY axis moment
               (dynamic mode only)

         Iyz = YZ axis moment
               (dynamic mode only)

         Ixz = XZ axis moment
               (dynamic mode only)



7-8    I2     Index that allows estimation and modification
              of selected parameters.


              ANALYTICAL MODEL:

                =10 right ascension

                =20 right ascension rate

                =30 declination

                =40 declination rate

                =50 prime meridian

                =60 prime meridian rate

                =70 prime meridian acceleration

                =11 Coefficient to cosωti term for Right Ascension

                =12 Coefficient to sinωti term for Right Ascension

                =21 Coefficient to cosωti term for Declination

                =22 Coefficient to sinωti term for Declination

                =31 Coefficient to cosωti term for Rotation

                =32 Coefficient to sinωti term for Rotation

                PLANOR11 up to PLANOR32 as a group of 6 cards,
```

may be repeated as many times as the number
of periodic terms. More than one parameter
may be selected and modified. When only one
parameter is selected (ex PLANOR10), then a
value for this parameter may be specified on
cols. 60-72 and a sigma may be specified on
cols. 73-80. In this case all the other
planetary orientation parameters (13 total)
will be fixed using a sigma = 1.D-20.

DYNAMIC MODEL:

  =10 right ascension

  =20 right ascension rate

  =30 declination

  =40 declination rate

  =50 prime meridian

  =60 prime meridian rate

  =01 Moment of inertia about X axis

  =02 Moment of inertia about Y axis

  =03 Moment of inertia about Z axis

  =04 XY axis moment

  =05 YZ axis moment

  =06 XZ axis moment

  For a theoretical description of the dynamic
  model, see volume 1 of the documentation,
  Section 8.16 - Orientation Initial Conditions - Variational Equations

17   I1   Index for the planetary body used in a binary asteroid case.
                =0 Default applies to one body
                =1 First body (orbited body)
                =2 Second body

25-44   D20.8   Period in earth seconds must be included
                on every PLANOR11, PLANOR21 and PLANOR31 card

60-72   D13.1   Value of parameter specified by index on   GEODYN
                col. 7-8.   defaults

        α = degrees

```
             dα/dt = degrees/Julian centuries of 36525 days

             δ = degrees

             dδ/dt = degrees/Julian centuries of 36525 days

             W = degrees

             dW/dt = degrees/day

             d2W/dt2 = degrees/day2

        Ai = degrees

        Bi = degrees

        Ci = degrees

        Di = degrees

        Ei = degrees

        Di = degrees

            Ixx = kg*m2

            Iyy = kg*m2

            Izz = kg*m2

            Ixy = kg*m2

            Iyz = kg*m2

            Ixz = kg*m2


73-80   D8.2    Sigma of parameter specified by index on
                col. 7. [NOTE 1]



NOTE[1]:  When planetary orientation parameters are adjusted, the GEODYN output
          summary expresses them in the frame and units of adjustment.  This
          is degrees of epoch J2000 and degrees/seconds for the rates.

NOTE[2]:
Units of PLANOR parameters in GEODYN
The PLANOR parameters are input to GEODYN via the PLANOR cards.
On the cards the units for the parameters are:
Right ascension α                        = degrees
Right ascension rate dα/dt               = degrees/Julian century of 36525 days
Declination δ                            = degrees
Declination rate dδ/dt                   = degrees/Julian century of 36525 days
Prime meridian angle W                   = degrees
Prime meridian angle  dW/dt              = degrees/day
Prime meridian angle d2W/dt2             = degrees/day**2
```

```
Ai Coefficient to costi term for RA    = degrees
Bi Coefficient to sinti term for RA    = degrees
Ci Coefficient to costi term for DEC   = degrees
Di Coefficient to sinti term for DEC   = degrees
Ei Coefficient to costi term for ROT   = degrees
Fi Coefficient to sinti term for ROT   = degrees


These values are in IIS (PLN subroutines) converted as follows and loaded
into PARMV(IPVAL(IXXTRO...)) and PARMV0(IPVAL0(IXXTRO..))


Right ascension $\alpha$            `                = radians
Right ascension rate d$\alpha$/dt            = radians/second
Declination $\delta$                         = radians
Declination rate d$\delta$/dt                = radians/second
Prime meridian angle W                       = radians
Prime meridian angle dW/dt                   = radians/second
Prime meridian angle d2W/dt2                 = radians/second**2
Ai Coefficient to costi term         = radians
Bi Coefficient to sinti term         = radians
Ci Coefficient to costi term         = radians
Di Coefficient to sinti term         = radians
Ei Coefficient to costi term         = radians
Fi Coefficient to sinti term         = radians


The values in PARMV(IPVAL(IXXTRO...)) and PARMV0(IPVAL0(IXXTRO..))
are not used in the formations of the partials as in all instances the PLANOR
parials are computed numerically and load into PMPA.
The numerical partials are computed in degrees.
For printing purposes (unit 6 in subroutine ESTIMG.f)
the parameter  values are converted to:


Right ascension                      = degrees
Right ascension rate                 = degrees/Julian century of 36525 days
Declination                          = degrees
Declination rate                     = degrees/Julian century of 36525 days
Prime meridian angle                 = degrees
Prime meridian angle rate            = degrees/day
Prime meridian angle acceleration    = degrees/day**2
Ai Coefficient to costi term         = degrees
Bi Coefficient to sinti term         = degrees
Ci Coefficient to costi term         = degrees
Di Coefficient to sinti term         = degrees
Ai Coefficient to costi term         = degrees
Fi Coefficient to sinti term         = degrees


For output to the EMAT file the values are
converted to the   units of the partials
Right ascension                      = degrees
Right ascension rate                 = degrees/sec
Declination                          = degrees
Declination rate                     = degrees/sec
Prime meridian angle                 = degrees
Prime meridian angle rate            = degrees/sec
Prime meridian angle acceleration    = degrees/sec**2
Ai Coefficient to costi term         = degrees
Bi Coefficient to sinti term         = degrees
Ci Coefficient to costi term         = degrees
```

```
Di Coefficient to sinti term          = degrees
Ei Coefficient to costi term          = degrees
Fi Coefficient to sinti term          = degrees


EXAMPLE SETUP FOR BINARY ASTEROIDS
PLANOR1          1                                              0.0000   .1D-40
PLANOR2          1                                                       .1D-40
PLANOR3          1                                             90.0000   .1D-40
PLANOR4          1                                                       .1D-40
PLANOR5          1                                              0.0      .1D-40
PLANOR6          1                                            360.0      .1D-40
PLANOR7          1                                                       .1D-40
PLANOR11         1            18973.4002                                 .1D-40
PLANOR12         1                                                       .1D-40
PLANOR21         1            18973.4002                                 .1D-40
PLANOR22         1                                                       .1D-40
PLANOR31         1            18973.4002                                 .1D-40
PLANOR32         1                                                       .1D-40
PLANOR1          2                                              0.0      .1D-40
PLANOR2          2                                                       .1D-40
PLANOR3          2                                             90.0000   .1D-40
PLANOR4          2                                                       .1D-40
PLANOR5          2                                              0.0      .1D-40
PLANOR6          2                                            360.0      .1D-40
PLANOR7          2                                                       .1D-40
PLANOR11         2            18973.4002                                 .1D-40
PLANOR12         2                                                       .1D-40
PLANOR21         2            18973.4002                                 .1D-40
PLANOR22         2                                                       .1D-40
PLANOR31         2            18973.4002                                 .1D-40
PLANOR32         2                                                       .1D-40
PLANOR 1         2                                     1.460096E+15  1.0D-40
PLANOR 2         2                                     1.517356E+15  1.0D-40
PLANOR 3         2                                     1.640224E+15  1.0D-40PLANOR 4
2                                    6.630338E+10  1.0D-40
PLANOR 5         2                                     2.955852E+10  1.0D-40
PLANOR 6         2                                    -2.040129E+11  1.0D-40
```

2.3.78 PLNOR2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLNOR2                                  0.01D0          0.01D0          0.01D0  0.01D0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT		DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLNOR2	Modification and/or estimation of planetary orientation parameters: All the parameters below are evaluated and input at J2000. (Continues from PLANOR)	
7-8	I2			
9	I1			
10	I1			
11-12	I2			
13-14	I2			
15-17	I3			
18-20	I3			
21-22	I2			
23	I1			
24	I1			
25-44	D20.8	DXGEO1	Used as an observation perturbation in the creation of numerical observation partial derivative. (RA and DEC)	0.01D0
45-59	D15.3	DXGEO2	Used as an observation perturbation in the creation of numerical observation partial derivative. (RA and DEC)	0.01D0
60-72	D13.1	DXFRC1	Used as an acceleration perturbation in the creation of explicit numerical acceleration partial derivative. (Rotation Prime Meridian)	0.01D0
73-80	D8.2	DXFRC2	Used as an acceleration perturbation in the creation of explicit numerical acceleration partial derivative. (Rotation Prime Meridian)	0.01D0

NOTES:

[1] There must be a PLANOR card in the setup deck.

[2] This card must be used in conjuction with columns 7-10 of the ALTIM2 card.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If PLANOR adjustment has been invoked, default values will be used.

2.3.79 PLATE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
PLATE
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```


COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-5   A5   PLATE - Requests application of
                 tectonic plate motion. A new
                 tectonic plate can be added or
                 values for the default model can
                 be overridden.

7-8   I2   Plate number.   0

                 =-2   Plate values from model NUVEL1
                        used.

                 =-1   Plate values from default model
                        AM0-2 used.

                 = 0   Plate values from default
                        model AM1-2 used.

                 =1-14 Plate values in default model
                        will be replaced by values from
                        columns 25-71 of this card.

                 >11   New plate number and values
                        from columns 25-72 will be
                        added to the model for this run.

25-44   D20.8   Angular velocity of plate in degrees   0.   DEG/MEGA-YRS
                 per million years.

45-59   D15.3   Latitude of axis of rotation of   0.   DEG
                 plate in degrees north.

60-72   D13.1   Longitude of axis of rotation of   0.   DEG
                 plate in degrees east.

NOTES:

 [1]   The user should assign plate numbers on the station cooordinate
        cards. (STAPOS subgroup) The plate numbers on the station coordinate
        correspond to the following plates.

                         Plate number   Plate

                              1   Africa
                              2   Antarctica
                              3   Arabia
                              4   Caribbean
                              5   Cocos
                              6   Eurasia

```
                    7               Australia
                    8               Nazca
                    9               North America
                    10              Pacific
                    11              South America
                    12              India
                    13              Juan de Fuca
                    14              Philippine
```

   [2]   See option card PLATIM to request station position printouts on
          selected dates.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: PLATE motion will not be applied.

2.3.80 PLATIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLATIM800101          810101.              820101.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLATIM - Sets the reference date for the station coordinates for plate motion and requests printing of station coordinates at specified dates. This option may only be used in conjunction with the PLATE option.	
7 - 8	I2	YY Year,month and day of refer-	80
9 -10	I2	MM ence date for station coord-	01
11-12	I2	DD inates.	01
25-44	D20.8	First date for printing station positions. (YYMMDD.)	0.
45-59	D15.3	Next date for printing station positions. (YYMMDD.)	0.
60-72	D13.1	Next date for printing station positions. (YYMMDD.)	0.
73-80	D8.2	Next date for printing station positions. (YYMMDD.)	0.

NOTES:

Any number of PLATIM cards may be included in your deck, but only one reference date may be used. If more than one reference date is found the last one will be used.

See option card PLATE to request application of the tectonic plate model. Inclusion of a PLATIM card without a PLATE card will NOT invoke the plate model.

IF CARD OMITTED: If PLATE motion is applied, the reference date will be 800101 and no additional station coordinate printouts will be made.

2.3.81 PLMOON

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLMOON     401                720000.0000000                    10000.00
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS
```

```
1-6      A6      PLMOON - Requests application and or adjustment of
                 planetary moon GM.  This option can be selected for up
                 to 5 moons.  The moons must be orbiting the central
                 body of the run.  This option is not to be used for the
                 following central bodies: Earth, Earth's moon, and the Sun.
                 Since, the moons selected by this option are not contained
                 in the JPL planetary ephemeris, the user must supply a
                 Keplerian ephemeris for each of the moons. The format and
                 file names for the ephemeris are described below.

12-14    I3      Indicates the moon for which this perturbation      NO DEFAULTS
                 should be applied.

                 Body numbers are in the following format:  COM
                 C - is central body of this run:
                       1 = Mercury
                       2 = Venus
                       4 = Mars
                       5 = Jupiter
                       6 = Saturn
                       7 = Uranus
                       8 = Neptune
                       9 = Pluto

                 M - number of this moon (up to 5 moons can be specified)

                 Example: Mars moon numbers could be:
                         Phobos - 401
                         Deimos - 402

25-44    D20.8 Universal gravitational constant times the mass    M**3/s**2
                 of the moon

                 Default values exist for the following bodies:
                 Phobos - 401 - 720000.0 M**3/s**2
                 Deimos - 402 - 120000.0 M**3/s**2

60-72    D13.1 Sigma value for above moon GM
```

MOON EPHEMERIS INFORMATION:

For each moon specified in a run, an ephemeris must be supplied to the
GEODYN IIE portion of the program. The file names used in the IIE setup
have the following construction:

                  MOON EPHEMERIS FILE NAME = MON###

        where ### is the particular moon number specified on the PLMOON card.

Thus, for a typical Mars run with 2 PLMOON cards (one for PHOBOS - 401 and

one for DEIMOS - 402) a moon ephemeris needs to be supplied for each moon.
An example of the file names follows:

                   MON401 - IIE ephemeris file for Mars moon #1 (PHOBOS)
                   MON402 - IIE ephemeris file for Mars moon #2 (DEIMOS)

The moon ephemeris file has the following format:

HEADER RECORD -> F10.2 -> constant bias to be applied to mean anomaly values.
DATA RECORDS -> 1X, I6, I5, F10.6, F16.3, F15.11, F16.9, 3F17.9
     WORD #1 -> I6   -> YYMMDD
     WORD #2 -> I5   -> 0HHMM
     WORD #3 -> F10.6 -> SECONDS INCLUDING FRACTION
     WORD #4 -> F16.3 -> SEMI-MAJOR AXIS (meters)
     WORD #5 -> F15.11-> ECCENTRICITY
     WORD #6 -> F16.9 -> INCLINATION (degrees)
     WORD #7 -> F17.9 -> LONGITUDE OF THE ASCENDING NODE (degrees)
     WORD #8 -> F17.9 -> ARGUMENT OF PERIGEE (degrees)
     WORD #9 -> F17.9 -> MEAN ANOMALY (degrees)

IF CARD OMITTED: Planetary moon perturbations will not be applied.

2.3.82 PLNEPH

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLNEPH
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLNEPH - Allows for correction to the ephemeris planet state vector by adjusting the orbital elements at an osculating epoch	
7-8	I2	Indicator of type of orbital elements	2
		1 Keplerian [NOTE 2] 2 Brouwer-Clemence Set III	
9-12	I4	Body identifier	none

```
                  0100 = Mercury
                  0200 = Venus
                  0300 = Earth
                  0301 = Earth's Moon
                  0400 = Mars
                  0500 = Jupiter
                  0600 = Saturn
                  0700 = Uranus
                  0800 = Neptune
                  0900 = Pluto
                  9999 = Sun

                  0001    <----
                  0002        |
                  0003        |
                  0004        |
                  0005        |    for possible celestial bodies
                  0006        |    in the supplementary ephemeris
                  0007        |
                  0008        |
                  0009        |
                  0010    <----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
13-14	I2	Element Indicator	none
		For each type of elements the following table indicates a number from 1 to 6	
21-24	I4	Year of the osculating epoch:YYYY [NOTE 3]	the beginning time of the run
25-44	D20.8	MMDDHHMMSS.SS of the osculating epoch. [NOTE 3]	the beginning time of the run
45-59	D15.3	Element correction (for type and component in cols. 7-8 and 13-14) for the osculating epoch	0.0

```
60-72    D13.1              Sigma for the value in cols. 45-59              0.0

73-80    D8.2
```

Note [1]: In order to adjust a particular element a non-zero sigma should
           be given for that element. Body ID is required on ALL PLNEPH cards.

Note [2]: Adjustment of Keplerian elements is not implemented at
           the present.

Note [3]: The user may specify a correction EPOCH later than the end of
           the arc but not earlier than the start time of the arc.

2.3.83 POLDYN

```
 POLDYN : There have been additions to the POLDYN capability starting with
          version 1802. A POLDYN card used with a version earlier than 1802
          works as before. However, the explanations have changed.


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
POLDYN        880901    0.                      0.                3.            3.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0



COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS


1-6      A6      POLDYN - Used to set options and define
                 parameters associated with two force
                 model effects and one surface deformation
                 effect. The two force model effects are:
                 (1) variations in the C21 and S21
                 gravitational coefficients due to variations
                 in the Earth's figure axis and (2) the ocean
                 pole tide, The surface deformation effect is
                 the solid Earth pole tide.

                 These three effects all depend on the crust-
                 fixed path of the Earth's spin axis and the
                 figure axis of the Earth.
                 The instantaneous location of the spin axis is
                 obtained from the polar motion series input
                 on unit 2. The figure axis however has a complex
                 motion of which ONLY the secular part is of
                 interest in the computation of the ocean pole
                 tide and solid Earth pole tide effects. The
                 secular component of the path of the instantaneous
                 spin axis is the same as the secular component
                 of the path of the figure axis. These are now
                 modeled as a line (linear path). The history
                 is sketched in the next paragraph.

                 Note that in the past, the IERS provided a
                 series of a "filtered" version of their C01 EOP
                 series, and that was used to approximate the
                 trajectory of the figure axis. After lengthy
                 investigations and a dedicated workshop in July
                 2017, the IERS has adopted a conventional linear
                 model to describe the secular trajectory of the
                 figure axis. There are two IERS Conventions chapters
                 that involve the new secular pole and products that
                 use it: Ch. 6 (solid and ocean pole tides) and
                 Ch. 7 where the secular pole is actually defined,
                 and the site displacements due to various sources
                 are computed. The final (online) versions of these
                 two re-writes can be obtained by the public from:

      Ch. 6 URL:  http://iers-conventions.obspm.fr/2010/2010_update/chapter6/icc6.pdf

      Ch. 7 URL:  http://iers-conventions.obspm.fr/2010/2010_update/chapter7/icc7.pdf
```

It is very important to understand that for
the computation of the rotational deformation
(whether solid Earth or ocean pole tide), the
relative coordinates {m1,m2} of the location
of the instantaneous spin axis with respect to
the location of the secular figure axis ,
MUST be obtained from the adopted linear model
for the secular path of the figure axis
and NOT from a filtered version of C01 as it was
done in the past. This will ensure that products
derived by different entities on the basis of
space geodetic data from ANY technique , i.e.
SLR , VLBI , GNSS or DORIS , will all be consistent.
The old IERS "mean pole"is now called the "secular
pole" and it is derived from a simple linear fit
of the C01 series over the period 1900 to 2015.
Under the new convention , the term "mean" is
NOT allowed , since there is nothing that is the
"mean" of anything in this realization.
The functional form of the model is:

Xs(t) = Xs(t0) + Xs_dot * (t -t0) ; and

Ys(t) = Ys(t0) + Ys_dot * (t -t0)

where "t" is time in years of 365.25 days and
t0 = 2000.0 is the reference epoch for the new
IERS secular pole model. The model adopted by
the IERS can be realized as follows:

Xs(t0) =   55.00 [mas]
Xs_dot =   1.677 [mas/y]

and:

Ys(t0) =   320.50 [mas]
Ys_dot =   3.460 [mas/y]

Column 14 of the POLDYN card is devoted to
defining the model used to approximate the
figure axis. In addition to that , column 14
dictates how the C21 and S21 gravitational
coefficients will be computed.

7   I1   If > 0, apply the ocean pole tide   0

8   I1   Only for versions 1802 and later   0
                    This column allows the degree of the
                    ocean pole tide model to be extended
                    past 99 (see cols 9-10).

9-10   I2   The degree of the ocean pole tide model.   0
                    The maximal degree is 60 for versions
                    prior to 1802. For versions 1802 and
                    later 360 is the max degree

```
14      I1      Describe the model used for the secular            0
                pole path (its use strongly recommended
                that the model   described below in
                columns 15-80 be used)

                Also define how the C21 and S21 gravitational
                coefficients will be computed. It is HIGHLY
                recommended that the NOTES (further below) be read
                before selecting an option on this column. The
                terminology used here is ONLY explained in the
                NOTES. Also note that options 0, 1, 2 and 3 be
                avoided. They are here only to explain previous
                conventions and GEODYN setup decks that may
                have used these.


                0 = A linear model is used for the secular path
                    of polar motion. The linear model can be
                    defined in columns 15-80. Only the "second path"
                    contribution to C21 and S21 is computed.
                    The second path contribution is made using
                    GEODYN's original formulation for the second
                    path. This option can be used with or without
                    the presence of a GEOPOL card.


                1 = The IERS2010 model is used for the secular path
                    of polar motion. This model is cubic for
                    times from 1976 to 2010, and linear after 2010.
                    Only the "second path" contribution
                    to C21 and S21 is computed.
                    The second path contribution is made using
                    GEODYN's original formulation for the second
                    path. This option can be used with or without
                    the presence of a GEOPOL card.

                2 = The IERS2010 model is used for the secular path
                    of polar motion. This model is cubic for
                    times from 1976 to 2010, and linear after 2010.
                    Both the "first path" and  "second path"
                    contribution to C21 and S21 are computed.
                    The second path contribution is made using
                    IERS2010 equation 6.22. This option should
                    only be used when a GEOPOL card is also present.

                3 = The IERS2010 model is used for the secular path
                    of polar motion. This model is cubic for
                    times from 1976 to 2010, and linear after 2010.
                    Only the  "second path" path contribution
                    to C21 and S21 is computed.
                    The second path contribution is made using
                    IERS2010 equation 6.22. This option should
                    only be used when a GEOPOL card is also present.

                4 = Available only in versions 1802 and later.
                    A linear model is used to describe the
                    secular motion of the figure axis. The linear
                    model is defined in columns 15-80.
```

Both the "first path" and "second path"
                    contribution to C21 and S21 are computed.
                    The second path contribution is made using
                    IERS2010 equation 6.22. This option should
                    only be used when a GEOPOL card is also present.

              5 = Available only in versions 1802 and later.
                    A linear model is used to describe the
                    secular motion of the figure axis. The linear
                    model is defined in columns 15-80.
                    Only the "second path" path contribution
                    to C21 and S21 is computed.
                    The second path contribution is made using
                    IERS2010 equation 6.22. This option should
                    only be used when a GEOPOL card is also present.

15-20   I6   Reference epoch "t0"for the linear model   Epoch time on
                of the secular pole in YYMMDD format.   EPOCH card

25-44   D20.8   Xs(t0) value corresponding to the secular   0.   MAS
                pole coordinate at the epoch t0
                specified in columns 15-20
                (intercept of the linear model for Xs)

45-59   D15.3   Ys(t0) value corresponding to the secular   0.   MAS
                pole coordinate at the epoch t0
                specified in columns 15-20
                (intercept of the linear model for Ys)

60-72   D12.8   Xs_dot drift rate for the secular pole   0. MAS/Yr.
                model specified in columns 25-44
                (slope of the the linear model for Xs)

73-80   D8.3   Ys_dot drift rate for the secular pole   0. MAS/Yr.
                model specified in columns 45-59.

Notes:

     Background Geophysics

The ellipsoidal shape of the Earth is caused by Earth rotation.
As the rotation axis of the Earth wanders (polar motion), the figure
axis of the Earth's ellipsoid changes location too. The wandering of
the Earth's figure axis can not quite keep up with the rotation axis.
All three effects covered by the POLDYN card are connected with this
lagging of the figure axis. To compute where the figure axis is, it is
necessary to have a model for the secular path of the Earth's rotation
axis. That is because the instantaneous figure axis is about 2/3 of the
distance from the actual rotation axis to the secular path of the
the rotation axis (closer to the secular path pole). Note that the
secular path of the rotation axis is the same as the secular path
of the figure axis. So, for the three effects connected with the
POLDYN card, the secular pole path model is compared to the location
of the actual pole (given by the polar motion series input on unit 2).

Models for the Secular Path of the Pole

GEODYN allows two secular path models: a linear model for the secular
path and the IERS2010 model which is cubic for times from 1976 to
2010, and linear after 2010. Once the model for the secular path is set,
then the ocean pole tide and the solid Earth tide deformation models
are also set (other than the fact that the user must specify the
degree to which the ocean pole tide will be modeled).

    C21 and S21

The remainder of this note is devoted to an explanation of the third
effect connected with the POLDYN card, the computation of the C21 and S21
gravitational coefficients. At this point it is worthwhile remembering
that C21 and S21 values mainly reflect the separation between two axes:
the instantaneous figure axis and the Earth fixed Z axis used to compute
the gravity field (there are also some small deformation effects).

    Connection Between C21, S21 and GEOPOL

The previous paragraph sets up the connection between the POLDYN
card and the GEOPOL card. Most modern GEODYN setup decks include
a GEOPOL card. If a GEOPOL card is not present, then the Z axis
of the gravity field is the same as the Earth's rotation axis. In this
case, the Z axis of the gravity field is not truly Earth fixed. In this
case, however, the Z axis of the gravity field is not separated very
much from the figure axis. If a GEOPOL card is present, then the
Z axis of the gravity field is truly Earth fixed. It is the same Z
axis as is used by stations. The separation between the gravity Z axis
and the rotation axis is large. The figure axis is near the spin axis, so
the separation is very roughly the size of polar motion.

Some of the options given on Col 14 of the POLDYN card are sensible
only if a GEOPOL card is present in the deck. Each option on col 14
spells out whether GEOPOL is required or not.

    Path 1 and Path 2 to the Figure Axis (from the Z axis of the gravity field)

It is clear that the choice of a model for the secular path of the rotation
axis along with the choice of using a GEOPOL card are needed for determining
the separation of the figure axis from the Z axis of the gravity field. It is
important to keep in mind that the figure axis is about 2/3 of the distance
from the actual rotation pole to the secular path pole. Also,
C21 and S21 are very roughly (ignoring some deformation effects)
given by:

C21 = SQRT(3)*X*C20 - X*C22 + Y*S22
S21 = -SQRT(3)*Y*C20 - Y*C22 - X*S22

Where the gravitational coefficients are normalized and X and Y
are angles in radians. X proceeds west (like X polar motion) from
the Z axis of the gravity field to the figure axis and Y proceeds
south (like Y polar motion) from the the Z axis of the gravity field.

Note that one can break the computation of C21 and S21 into multiple
sub-paths that connect from the Z axis of the gravity field to the
figure axis. Each path would have its own X and Y angle. It is only
necessary that the sub-paths form a connected complete path.

There are two cases depending on the GEOPOL card (or the lack of one):

Case 1 (the most likely) GEOPOL option has been selected:

The path from the Z axis of the gravity field to the figure
axis is broken into two paths:

Path (1): Gravity Z axis to secular path pole

then

Path (2): secular path pole to instantaneous figure axis

If the the contribution from the first path is computed analytically,
it would be given by:

C21_part1 = SQRT(3)*xp_sec*C20 - xp_sec*C22 + yp_sec*S22
S21_part1 = -SQRT(3)*yp_sec*C20 - yp_sec*C22 - xp_sec*S22

Depending on the setting in Col 14, this part1 contribution may be computed
by GEODYN. If it is not computed by GEODYN, then it must be modeled and/or
estimated using GCOEF and GRVTIM cards.

The contribution from the second path can be modeled using one of
two methods depending on how Col 14 is set:

Method (1) for second path contribution is GEODYN's original formulation:

C21_part2 = SQRT(3)*C20*Kf*(xp - xp_sec)
S21_part2 = -SQRT(3)*C20*Kf*(yp - yp_sec)

where Kf is defined on the POLKF card and should
be about 1/3 , The polar motion values are in radians.

Note that when GEODYN's original formulation for the contribution from
the second path is chosen, the contribution from the first path is NOT computed.
In this case the user MUST model and/or estimate C21_part1 and S21_part1 with a
combination of GCOEF and GRVTIM cards.

```
Method (2) for second path contribution is according to
IERS2010 equation 6.22:


C21_part2 = -1.333E-9*(m1 + 0.0115*m2)
C21_part2 = -1.333E-9*(m2 - 0.0115*m1)
m1 =   xp-xp_sec
m2 = -(yp-yp_sec)


Here the polar motion values are in seconds of arc.


Note that when the IERS2010  formulation for C21 and
S21 is selected , C21_part1 and S21_part1 may be computed by
GEODYN depending on Col 14.



The two ways of computing the second path contribution are roughly
equivalent except that the IERS2010 approach uses Love numbers
and takes into account deformation. The factor of 1.333E-9
has approximately the same factors built into it as GEODYN's
original approach (plus a conversion from seconds of arc to radians).


Remember that both approaches for the second path contribution
depend on the fact that the second path starts at the secular
path pole and heads in the direction of the instantaneous rotation axis.


This is why the factor 1/3 is built into the second path contribution.
If the full path went through the actual pole, the second path
would start at the actual pole and head towards the secular
path pole. The absolute value of the 1/3 factor
would change to 2/3 and either the sign of the factor would flip or
equivalently m1 would be xp_sec-xp and m2 would change to -(yp_sec-yp),
Also the  computation for the first path  would
depend on actual polar motion , not the secular path values.
It probably makes more sense to use the secular path because the more
delicate second path computation (which involves deformation) is
smaller when one starts at the secular path , At any rate , this is
way the IER2010 conventions have it.



Case 2  GEOPOL option has NOT been selected
      (this is given only to interpret old setups):
-----------------------------------------------------

Nowadays , this would be a rare case. If no GEOPOL card is
present , then there is no first path (the overall path would
start close to the figure axis) and no need for the C21_part1
and S21_part1 computations mentioned in Case 1 (GEOPOL).


As far as C21_part2 and S21_part2 go , the IERS210 formulation:


C21_part2 = -1.333E-9*(m1 + 0.0115*m2)
C21_part2 = -1.333E-9*(m2 - 0.0115*m1)
m1 =   xp-xp_sec
```

```
m2 = -(yp-yp_sec)
```

can not be used without some modification. It has a factor of
1/3 built into it somewhere. This would need to be changed to
-2/3 because the path from the gravity Z axis starts at the
actual rotation pole. The modified version of this is NOT
available in GEODYN.

The only sensible selection for C21 and S21 computation when
there is no GEOPOL card is GEODYN's original formulation:

```
C21_part2 =  SQRT(3)*C20*Kf*(xp - xp_sec)
S21_part2 = -SQRT(3)*C20*Kf*(yp - yp_sec)
```

where Kf is defined on the POLKF card and should
be about -2/3 ,

Using GCOEF and GRVTIM cards When Col 14 Excludes the Part 1 Contribution
----

When GEODYN computes the part 1 contribution to C21 and S21 the following
equation is used:

```
C21_part1 =  SQRT(3)*xp_sec*C20 - xp_sec*C22 + yp_sec*S22
S21_part1 = -SQRT(3)*yp_sec*C20 - yp_sec*C22 - xp_sec*S22
```

To have GCOEF and GRVTIM cards mimic this the user will need to evaluate
the above equations at the epoch of the GRVTIM cards to get the values used
on the GCOEF cards for the C21 and S21 coefficients. The rates used on the
GRVTIM cards will come from differentiating the secular path model for the pole
and then evaluating:

```
C21_part1_dot =  SQRT(3)*xp_sec_dot*C20 - xp_sec_dot*C22 + yp_sec_dot*S22
S21_part1_dot = -SQRT(3)*yp_sec_dot*C20 - yp_sec_dot*C22 - xp_sec_dot*S22
```

IF CARD OMITTED: Dynamic polar motion will not be applied.

2.3.84 POLE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
POLE  0                 780903.              176.         421.        17.0842
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

1-5   A5   POLE - Modifies polar motion and/or
                  A.1-UT1 values obtained from the BIH
                  tables file on unit 2.

7   I1   Indicator of whether X of the pole, Y of
                  the pole or A.1-UT1 (or any combination of
                  the 3) are to be replaced by the values on
                  this card.

                     Col 7   Values to be replaced

                     =   0   Xp   Yp   A.1-Ut1
                     =   1   Xp
                     =   2   Yp
                     =   3   Xp   Yp
                     =   4   A.1-Ut1
                     =   5   Xp   A.1-Ut1
                     =   6   Yp   A.1-Ut1

25-44   D20.8   Date of pole/A.1-UT1 value. (YYMMDD.HH)   0.
                  This must correspond exactly with the BIH
                  date that is being overridden.

45-59   D15.3   Value of X of the pole.   0.   MAS

60-72   D13.1   Value of Y of the pole.   0.   MAS

73-80   D8.2   Value of A.1-UT1.   0.   S

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
       DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Values from tables file on UNIT 2 will be used.

2.3.85 POLEUT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
POLEUT23              860104.          22.72530      0.1890        0.1639
----+----0----+----0----+----0----+----0---+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   POLEUT - Used to modify and/or request
                adjustment of true pole coordinates
                and A.1-UT1 time differences. If the user
                choses option 4 on col.7, then modification
                and/or adjustment of EOP rates is introduced
                as well.

7   I1   = 0   No parameter adjustment.   0
                > 0   Parameter adjustment requested.
                < 2   Third card not present in this group.
                = 2   Pole adjustment constrained along the great
                      circle passing through the pole and defined
                      by the longitude specified in columns
                      25-44 of the third card in this group
                = 3   Adjusted parameter a priori correlations
                      provided on the third card in this group.
                = 4   Adjust EOP rates [NOTE 2]

8   I1   = 0   Pole and A.1-UT1 values are obtained from   0
                      POLEUT card.
                = 1   Pole values are obtained from tables;
                      A.1-UT1 obtained from POLEUT card.
                = 2   Pole values obtained from POLEUT card;
                      A.1-UT1 obtained from tables.
                = 3   Pole and A.1-UT1 values obtained from
                      tables.

25-44   D20.8   Date in form YYMMDD.FFF of pole and A.1-UT1   No default.
                values[1] to which this card applies. This
                date is for the midpoint of the interval
                specified in columns 25-44 of card two.

45-59   D15.3   A.1-UT1 value[1].   See col. 8. (S)

60-72   D13.1   X of pole[1].   See col. 8. (SA)

73-80   D8.2   Y of pole[1].   See col. 8. (SA)

SECOND CARD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
                        5.0            0.01          0.1           0.1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```


COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

```
1-23       23X     Blanks must be present.

24         I1      =1 the units for the below averaging interval is hours   0
                   =0 the units for the below averaging interval is days

25-44      D20.8   Averaging period[1] in the above units for      No default.
                   pole and A.1-UT1 values. The date in columns
                   25-44 of the first card is for the midpoint
                   of this interval

45-59      D15.3   A priori standard deviation in A.1-UT1.         0.0    (S)

60-72      D13.1   A priori standard deviation in X of pole.       0.0    (SA)

73-80      D8.2    A priori standard deviation in Y of pole.       0.0    (SA)


THIRD CARD
----------


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
                            280.0              0.0              0.0            0.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


1-24       24X     Blanks must be present.

25-44      D20.8   Longitude of great circle constraint for     See col. 7. (DEG)
                   X and Y of pole.

45-59      D15.3   A priori cross correlation between A.1-UT1      0.0   Unitless
                   and X of pole.

60-72      D13.1   A priori cross correlation between A.1-UT1      0.0   Unitless
                   and Y of pole.

73-80      D8.2    A priori cross correlation between X of pole    0.0   Unitless
                   and Y of pole.


FOURTH CARD
-----------

---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
                                      0.0              0.0            0.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

1-24       24X     Blanks must be present.

45-59      D15.3   A priori standard deviation for X-pole rate

60-72      D13.1   A priori standard deviation for Y-pole rate

73-80      D8.2    A priori standard deviation for A.1-UT1 rate
```

IF CARD OMITTED: DEFAULT VALUES GIVEN ABOVE ARE USED.

NOTE: [1] Values provided in columns 45-80 of first card are differenced
          with interpolated table values for specified date (cols. 25-44)
          and differences are applied as a discrete offset over entire
          averaging interval (second card cols. 25-44).
NOTE: [2] Normally (GEODYN default) the EOP at a given time t are
          computed in GEODYN from the table values using biquadradic
          interpolation. When option 4 on col. 7 s chosen then EOP rates
          are requested and the model changes. In this case to compute
          the EOP at a given time t, we use the linear model

$$P_T = P_t + \dot{P}_{(t-T)} \quad \text{where } P_t \text{ is the value of the earth orientation}$$

          parameter from the tables at time t and $\dot{P}$ is the rate
          computed at t using the tables values $P_{(t-1)}$ and $P_{(t+1)}$
          This model should be used with the 1-day pole tables.

UNITS: DEG-DEGREES; S-SECONDS; SA-SECONDS OF ARC

IF CARD OMITTED: DEFAULT VALUES GIVEN ABOVE ARE USED.

2.3.86   POLKF

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
POLKF                    -.66667
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   POLKF requests application and or adjustment
                  of the Kf factor described in the POLDYN
                  documentation (see Note(1)).

25-44   D20.8   Kf factor. [NOTE 1,2]   -2./3.

45-59   D15.3   Standard deviation for Kf.   0.

NOTE[1]: This option is tightly connected to the GEOPOL
         and POLDYN options. The documentaion for the
         GEOPOL option should be read first, then
         the documentation for the POLDYN card should
         be read.

NOTE[2]: If a GEOPOL card is present, Kf must be > 0. If Kf < 0 is
         desired, use GEOPOL1. See GEOPOL card documention.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
         MAS=Milliarc seconds

IF CARD OMITTED: The default value of -2./3. will be used for the figure
                  axis scale factor. Dynamic polar motion will not be
                  applied unless the POLDYN option is selected.

2.3.87 POLTID

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
POLTID
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS


1-6     A6      POLTID - Request application of pole
                tide on station positions. THIS REQUIRES
                THE DEFINITION OF A MODEL FOR THE MEAN
                PATH OF POLAR MOTION. This model must
                be specified on the POLDYN card.
                Unfortunately, versions prior to 1802
                will proceed to compute an invalid
                POLTID correction without a POLDYN card.



IF CARD OMITTED:  The pole tide correction will not be applied.
```

2.3.88   PRNTVU

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PRNTVU 222
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PRNTVU - Requests suppression of output of selected GEODYN-IIS and GEODYN-IIE printout items to unit 6.	
7-8	I2	Specifies either the number of lines per page to be output on unit 6. 6 - 61 lines per page. 8 - 81 lines per page. >20 - specific number of lines per page.	61
9-17	9I1	For columns 9-17 the following applies: Blank or zero - Default will apply 1 - .False. - GEODYN-IIS output suppressed. 2 - .True. - Requests GEODYN-IIS output.	
9	I1	Simple list of GEODYN-IIS setup.	2 - .TRUE.
10	I1	Interpretive list of GEODYN-IIS setup.	1 - .FALSE.
11	I1	Observation block selection report.	1 - .FALSE.
12	I1	Gravity model coefficients.	2 - .TRUE.
13	I1	Global parameter values and sigmas.	2 - .TRUE.
14	I1	Arc parameter values and sigmas.	2 - .TRUE.
15	I1	Sea surface topography.	1 - .FALSE.
16	I1	Ocean Tide Model.	2 - .TRUE.
17	I1	Reserved for GEODYN-IIS.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	7I1	For columns 18-24 the following applies: Blank or zero - Default will apply 1 - .False. - GEODYN-IIE output suppressed. 2 - .True. - Requests GEODYN-IIE output.	
18	I1	Simple list of GEODYN-IIS setup.	2 - .TRUE.
19	I1	Values of estimated E-biases.	1 - .FALSE.

20	I1	E-matrix labels in Summary Page.	1 - .FALSE.
21	I1	Adjusted station baselines.	1 - .FALSE.
22	I1	Correlations for adjusted parameters.	2 - .TRUE.
23	I1	Shadow crossing.	1 - .FALSE.
24	I1	Reserved for GEODYN-IIE.	

IF CARD OMITTED: Defaults apply.

2.3.89 PUNCH

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
PUNCH
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   PUNCH - Requests punched output on
                unit 7 for complete setup deck or for
                adjusted parameters only.

8   I1   Punched output control.   0

                = 0 Requests that complete setup deck be
                     punched with all estimated para-
                     meters replaced by the adjusted values.

                = 1 Requests that only updated parameters
                     be punched.

9   I1   Iteration control for punched output   0

                = 0 Requests that punching occur on last
                     inner of each global iteration

                = 1 Requests that punching occur on all
                     iterations

IF CARD OMITTED: No punched output will be generated.

2.3.90 RAYTID

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
RAYTID
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   RAYTID - Request application of the
                IERS convention Earth Tides and the
         Doodson Ocean Tide model

IF CARD OMITTED: The default tide models will be applied. See ETIDES and
OTIDES options.

2.3.91 REFRAC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
REFRAC 1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   REFRAC - Specifies the tropospheric
                 model to be used for tropospheric
                 corrections to the observations.

8   I1   Model selection number   0
                  = 0 Hopfield Model
                  = 1 Marini Murray Model [NOTE 1]
                  = 2 VLBI/GPS
                  = 3 GPS Model using Niell mapping functions
                  = 4 Marini Murray for laser data
                      Model 03 for nonlaser data
                  = 5 Mendez (Porto) model for laser data
                  = 6 GPT is used to calculate pressure and
                      temperature; Hopfield model is used to
                      calculate the apriori hydrostatic zenith
                      delay; GMF is the mapping function.
                  = 7 Option 7 is the same as option 6 except
                      that Saastamoinen model is used to calculate
                      the apriori hydrostatic zenith delay.
                  = 8 VMF1 [NOTE 3]

                      [NOTE 2]

9   I1   Correction Component Applied   0
                  For all models 0-4
                  This correction pertains to the wet and dry
                  correction carried on the 3rd and 4th word of
                  the observation corrections record. These corrections
                  will be added to the sum of observation corrections
                  which later on in GEODYN will be subtracted from the
                  residual.
                      = 0 Wet and Dry
                      = 1 Wet Only
                      = 2 Dry Only
             (!NOTE!)   For the time being (GEODYN version 0812) ONLY
                  the index=0 is true to the description. As soon
                  as the problem will be fixed, this comment will be
                  removed.

                      (For Mendez Model only)

                      =0 Use Mapping Function dependent on latitude,
                          height and temperature
                      =1 Use Mapping Function with no dependence on
                          meteorological data

10   I1   Scale Factor Adjustment   0
                  For all models 0-7
                  = 0 K*(Wet + Dry)
                  = 1 K*Wet Only
```

```
11      I1      Wet Component Mapping Function (Model 2 only)      0
                = 0 Chao
                = 1 CFA2.2

12      I1      Dry Component Mapping Function (Model 2 only)      0
                = 0 Chao
                = 1 CFA2.2

13      I1      SWITCH FOR PRINT OF TROP EBIAS AND ZENITH
                PATH DELAYS                                        0
                = 0 No print out
                = 1 Print zpds and trop EBIAS (UNIT 400)

15-17   I3      Measurement type
```

NOTES:

 [1]   The Marini Murray model is only available for laser range data.   If
       the Marini Murray model is selected (column 8 =1) and data other
       than laser range is present, the Hopfield model will be used
       for all non laser range data and the Marini Murray model will be used for
       the laser range data.

 [2]   MODELS   NON-LASER   LASER
       ----
          0   HOPFIELD   HOPFIELD
          1   HOPFIELD   MARINI-MURRAY
          2   VLBI/GPS   VLBI/GPS
          3   GPS/NEIL   GPS/NEIL
          4   GPS/NEIL   MARINI-MURRAY
          5   HOPFILED   MENDEZ
          6   GMF/HOPFIELD   GMF/HOPFIELD
          7   GMF/SAASTAMOINEN GMF/SAASTAMOINEN
          8   VMF1   VMF1

 [3] VMF compressed data files may be found on xyz2 in the following directory:

      /users/geodyn/SUPPORT/dat_FILES/dat_VMF/VMF_GRID_FILES
      The user must select the VMF file that covers their arc.
      The name of the VMF file features the covered dates.
      The VMF files usually cover several months and have adequate
      overlap to cover all date ranges.

      The presence of an ascci file with the name 'orography_ell.txt' IS
      REQUIRED in the directory where GEODYN IIE is executed. The file may be
      found in the same directory as above
      /users/geodyn/SUPPORT/dat_FILES/dat_VMF/VMF_GRID_FILES
      OR on this documentation main page under the name :
      VMF OROGRAPHY FILE (MEAN GRID VALUES)

      When using the VMF refraction model in GEODYN IIS will produced an
      interface file with the name 'vmf_interface_file' which will contain the
      data in the time range requested by the user.

      If any of the two files , vmf_interface_file, and orography_ell.txt
      are not present or not created, GEODYN will terminate with a
```

comprehensive error message.


IF CARD OMITTED:  Hopfield model will be used for non laser range data.

 (!NOTE!) The default below is not accurate as of GEODYN 0812. When the
 default for laser data is fixed, we will remove this comment.

                    Marini Murray model will be used for laser range data.

**2.3.92  REL300**

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
REL300
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   REL300 - Requests that relativistic
                 corrections be applied for earth
                 orbiting satellites. This includes
                 general relativistic light time corrections
                 to the measurement model, general
                 relativistic point mass accelerations,
                 and the Lense-Thirring effect, and the
                 relativistic coriolis force.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
         MAS=Milliarc seconds

IF CARD OMITTED: Relativistic corrections will not be applied.

2.3.93 RELPPN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
RELPPN                                   1.D+00          1.D-30          1.D+00  1.D-30
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                            DEFAULT VALUE & UNITS

1-6      A6      RELPPN - Introduces the PPN relativity model. The third-body
                         perturbation of each body (Sun, planets and asteroids)
                         is derived from the isotropic, parametrized
                         post-Newtonian  (PPN) n-body metric.
                         The acceleration of the spacecraft and the integrated
                         body due to interaction with other point masses follows
                         the formulation reported in Eq. 27 of :
                         " The Planetary and Lunar Ephemerides DE430 and DE431 "
                         by Folkner et al. 2014.
                         There are two parameters associated with this model,
                         Gamma and Beta
                         [NOTE 1]
                         Use RELPPN only for Interplanetary satellites [NOTE 2]

25-44   D20.8   Value of Gamma

45-59   D15.3   Sigma for Gamma

60-72   D13.1   Value of Beta

73-80   D8.2    Sigma for Beta


NOTE 1. The presence of both RELPPN and REL300 in a GEODYN setup sets
        RELPPN to be the used model. GEODYN will not double count the
        relativistic effect.
NOTE 2. RELPPN cannot be used for Earth orbiting satellites because of
        reference frame computation issues.
```

2.3.94 SATCUT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
SATCUT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SATCUT - Gives the user the ability to set an elevation cut off angle for satellite to satellite links in measurements. The cut off angle for satellite to satellite links is reckoned from the horizon of the lower satellite. The default value is 0	

2.3.95   SCBODY

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SCBODY
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SCBODY - Allows the user to overwrite values and request adjustment of physical parameters of a celestial body featured in the EPHEM2 global option. (Supplementary Planetary Ephemeris)	
7	I1	Gravity model initialization indicator. = 0 Gravitational coefficients are initialized from the gravity model file. The option to modify the coefficients using GCOEF, GCOEFC, and GCOEFS cards is not yet applicable. > 0 (See PLANET card) Not Available yet.	
8-10	I3	Celestial body sequence in the supplementary planetary sequence.	
11-17	I7	Celestial body ID.	
18-20	I3	Max degree of coefficient to be used in the gravitational model.	
21-23	I2	Max degree of coefficient to be used in the gravitational model.	
24	I1	Indicator of the contents of the real fields (col 25-80). = 0 Columns 25-80 contains the values of GM, A, 1/fp, 1/fe = 1 Columns 25-80 contains the sigmas of GM, A, 1/fp, 1/fe	
25-44	D20.8	Universal gravitational constant times the mass of the body (GM) or sigma value if column 7 = 1	
45-59	D15.3	Semi-major axis of the body (A) or sigma value if column 7 = 1	
60-72	D20.8	Inverse of the body's polar flattening (1/fp) or sigma value if column 7 = 1	
73-80	D20.8	Inverse of the body's equatorial flattening (1/fp) or sigma value if column 7 = 1	

```
IF CARD OMITTED:   Values of planetary physical parameters
                   from the supplementary planetary ephemeris
                   will be used.
```

2.3.96 SHDEND

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
SHDEND
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SHDEND - Denotes the end of the GPSSHD group

IF CARD OMITTED: Abnormal termination

2.3.97 SSCOEF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSCOEF2        2  1                                            1.0000000D-091.00D-09
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSCOEF - Modifies and/or requests the estimation of spherical harmonic coefficients in static sea surface topography model.	
7	I1	Normalization indicator [NOTE 1]	1
		= 1 values normalized C,S = 3 values unnormalized C,S [See NOTES]	
15-17	I3	Degree of C and S coefficients (N index).	0
18-20	I3	Order of C and S coefficients (M index).	0
25-44	D20.8	A priori (or starting) value of C coefficient. [NOTE 2]	0.
45-59	D15.3	A priori (or starting) value of S coefficient. [NOTE 2]	0.
60-72	D13.1	Standard deviation of C coefficient. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation of S coefficient. No adjustment if this field is zero.	0.

NOTES:
  [1]   The denormalization subprogram in GEODYN underflows at degree
        49 and order 48.

        The geopotential coefficient denormalization equation used is:

$$C_n^m = \bar{C}_n^m \times D_n^m$$
$$S_n^m = \bar{S}_n^m \times D_n^m$$

        where

$$D_n^m = \sqrt{(4n+2)\frac{(n-m)!}{(n+m)!}} \text{ for } m > 0$$

$$D_n^m = \sqrt{2n+1} \text{ for } m = 0$$

        and
        C_n^m, S_n^m are un-normalized coefficients.

$\bar{C}_n^m$, $\bar{S}_n^m$ are normalized coefficients.

The denormalization subprogram in GEODYN underflows at degree 49 order 48.

[2]   If the degree and order on the SSCOEF card must be less then or equal to the maximum degree and order as input on the SSTOPO card.

[3]   If it is desired that the starting values of coefficients be different than the a priori values for those coefficients then the SSCOEF card should be used as follows:

o   SSCOEF cards requesting the desired coefficient adjustments should be included in the setup deck. The a priori values will be indicated on these cards.

o   For each coefficient pair for which the starting value is to be different than the a priori value, an additional SSCOEF card should be in the setup deck. This SSCOEF card will indicate the starting value and come later in the deck than the corresponding SSCOEF card requesting adjustment.

IF CARD OMITTED: Static Sea Surface Topography model will be null.

2.3.98   SSTCOF

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
SSTCOF
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SSTCOF - Provides the apriori values
                  for the coefficients needed for sea
                  surface topography height evaluation.

25-44   D20.8   A priori value for coefficient.

60-72   D13.1   Standard deviation for coefficient.   0.
                  No adjustment if this field is zero.

NOTE [1]:   A stream of SSTCOF cards should follow the SSTMOD card
            (See SSTMOD Vol. 3).

IF CARD OMITTED: And SSTMOD has been requested the run will terminate
                   abnormally.

2.3.99 SSTMOD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSTMOD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

1-6   A6   SSTMOD - Introduces the application/
                estimation of a sea surface topography
                model which employs a number of functions
                evaluated at several points located on
                a uniform grid on the globe. The sea
                surface topography height at a given
                location is evaluated by interpolation
                and represents the height from the geoid
                to the mean sea surface. The user may
                input the grid file either in IIS or in
                IIE. For large grid files IIE input is
                recommended.

7-8   I2   = 0 Function file input from IIE [2]   0   27,28

                = 1 Function file input from IIS [3]   21

9-10   I2   Input file number for the Proudman
                function SST coefficients. Recommended
                units are 45-49

11-12   I2   Number of real variables on one record of
                the above input file. Each record should
                include all the coefficients that describe
                one function in the following order:
                constant term
                periodic terms -

13-14   I2   Internal geodyn number that describes the
                function model

                 1 = constant term only
                 8 = periodic terms for one frequency
                 9 = periodic terms for two frequencies
                10 = periodic terms for three frequencies

15-17   I3   Index for printing a coefficient report on
                unit 6 of the GEODYN IIS output

                =0 No report will be printed

                =1 A coefficient report will be printed

25-44   D20.8   Period for model 8 (sec)

45-59   D15.3   Period for model 9 (sec)

60-72   F13.1   Period for model 10 (sec)

```
73-80    F8.1    Editing factor for boundary locations
                 editing. This must be a real number between
                 0.D0 and 1.D0.


NOTE [1]:    This card must be followed by a number of SSTCOF cards which
             represent the total number of functions evaluated per grid
             point.

NOTE [2]:    Files input from IIE:
             Two files (units 27 and 28) must be brought into the directory
             where GEODYN will execute.  These files which are specific to the
             machine on which they are used, represent the direct access
             function file (27) and the matching grid file (28).  See Vol. 5
             Sect. 2.10 for a description of the files

NOTE [3]:    File input from IIS:  unit 21
             See Vol. 5, Section 2.10 for description of the file.

IF CARD OMITTED:  The above described Sea surface topography model will
                  not be applied.
```

2.3.100 SSTOPO

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSTOPO
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTOPO - Defines the altimetric sea surface topography model maximum degree and order and the epoch time for the time dependent terms.	
8	I1	Sea surface topography model print control switch. = 1 Print entire model. = 2 Print only model checksum.	2
15-17	I3	Maximum degree of coefficient to be used in the spherical harmonic expansion of the sea surface topography model.	3
18-20	I3	Maximum order of coefficient to be used in the spherical harmonic expansion of the sea surface topography model.	2
25-44	D20.3	Epoch time in YYMMDDHHMMSS.SS for the time dependent sea surface topography linear rate and periodic terms.	

IF CARD OMITTED: Sea surface topography computations will not be performed.

2.3.101 SSTPRD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSTPRD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SSTPRD - Modifies and/or requests the
                  estimation of the periodic sine and
                  cosine coefficients for the C or S
                  spherical harmonic coefficients in sea
                  surface topography model. Defines the
                  periodic frequency.

7   I1   Normalization indicator   1

                  = 1 values normalized C,S
                  = 3 values unnormalized C,S

8   I1   Coefficient type   0

                  = 1 Coefficient of Cosine (C)
                  = 2 Coefficient of Sine (S)

9   I1   Frequency/Period indicator   1
                  (frequency=2*pi/period)

                  = 1 Annual   (365.2524 days)
                  = 2 Semi-annual   (182.6262 days)
                  = 3 Seasonal   (91.3131 days)
                  = 4 Monthly   (30.4377 days)
                  = 5 To be defined in columns 10-14

10-12   I3   Integer number of days in period   0

13-14   I2   Fractional number of days in period   0

15-17   I3   Degree of C or S coefficients   0

18-20   I3   Order of C and S coefficients   0

25-44   D20.8   A priori value of the cosine coefficient (a)   0.

45-59   D15.3   A priori value of the sine coefficient   (b)   0.


```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSTPRD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

60-72   D13.1   Standard deviation of the cosine coefficient.   0.
                  No adjustment if this fields is zero.

73-80   D8.2   Standard deviation of the sine coefficient (b). 0.
                  No adjustment if this field is zero.

NOTE: Card must be used in conjunction with SSTOPO card.
        Card cannot be used in conjunction with SSCOEF card.

IF CARD OMITTED: Periodic terms not included in sea surface
                   topography computations.

2.3.102 SSTTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SSTTIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTTIM - Modifies and/or requests the estimation of the mean and secular spherical harmonic coefficients in sea surface topography model.	
7	I1	Normalization indicator	1
		= 1 values normalized C,S = 3 values unnormalized C,S	
8	I1	Coefficient type	0
		= 1 Coefficient of Cosine (C) = 2 Coefficient of Sine (S)	
15-17	I3	Degree of C or S coefficients	0
18-20	I3	Order of C and S coefficients.	0
25-44	D20.8	A priori (or starting) value of the mean Cbar or Sbar coefficient.	0.
45-59	D15.3	A priori (or starting) value of the Cdot or Sdot linear rate coefficents.	0.
60-72	D13.1	Standard deviation of the mean Cbar or Sbar coefficent. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation of the secular Cdot or Sdot coefficent. No adjustment if this field is zero.	0.

NOTE: Card must be used in conjunction with SSTOPO card.
       Card cannot be used in conjunction with SSCOEF card.

IF CARD OMITTED: Cbar, Sbar, Cdot, Sdot terms not included in sea
                  surface topography computations.

2.3.103 STIERS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STIERS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   STIERS - Request application of the
                 IERS (DEHANT) model for solid earth
           tides

IF CARD OMITTED: The default default simple model will be applied.

2.3.104 TARGET

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TARGET
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                       DEFAULT VALUE & UNITS

1-6      A6      TARGET - Introduces coordinates of a
                 station on a planet other than the earth.

7        I1      Type of planet centered fixed coordinates       0

                 =0 - X,Y,Z (Cartesian)                      0.         M
                 =1 - latitude,longitude,radius (Spherical)   0.   degrees or M
                 =2 - axis, longitude, height (Cylindrical)   0.   degrees or M

18-24    I7      Target ID number.

25-44    D20.8   X (meters), φ (latitude in degrees) or A (axis in meters)

45-59    D15.3   Y (meters) or λ (west longitude in degrees)

60-72    D13.1   Z (meters), r (radius in meters) or H (height in meters)
```

2.3.105 TARSIG

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TARSIG
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                        DEFAULT VALUE & UNITS

1-6      A6       TARSIG - Introduces sigmas for
                  the coordinates of a planetary
                  station (Target).

18-24    I7       Target ID number.

25-44    D20.8    sigma of X (meters), φ (latitude in degrees)
                  or A (axis in meters)

45-59    D15.3    sigma of Y (meters) or λ (west longitude in degrees)

60-72    D13.1    sigma of Z (meters), r (radius in meters) or H (height in meters)


IF CARD OMITTED:  And measurement types 37, 38, 47 or 48 are being processed
planetary target coordinates will not be solved for.
```

2.3.106 TERMVU

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TERMVU 222
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TERMVU - Requests output of selected IIE printout items to unit 9 where the linesize is 80 characters.	
		For columns 9-18 the following applies:	
		Blank or zero - default will apply 1 - .False. - means no output 2 - .True. - requests output	
9	I1	Requests output of GEODYN-IIS setup.	1 - .FALSE.
10	I1	Iteration control .	2 - .TRUE.
		= 1 Requests items selected by columns 11-15 be output on each iteration.	
		= 2 Requests items selected by columns 11-15 be output on last inner iteration of each global iteration.	
11	I1	Requests output of observation residuals.	1 - .FALSE.
12	I1	Requests output of station residual summary.	1 - .FALSE.
13	I1	Requests output of observation type residual summary.	2 - .TRUE.
14	I1	Requests output of E-BIAS adjustment.	1 - .FALSE.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15	I1	Requests output of arc parameter adjustments.	2 - .TRUE.
16	I1	Requests output of summary page.	2 - .TRUE.
17	I1	Requests output of global parameter adjustments.	2 - .TRUE.
18	I1	Requests output of arc global update.	2 - .TRUE.

IF CARD OMITTED: Default values will be used to control output to UNIT 9.

2.3.107 TIDES

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TIDES 20                 .29
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	TIDES - Modifies Earth tide perturbation and requests application of pole tide. The default model for standard tides is the one that applies K2 amplitude, K2 phase and K3 amplitude. An extended model may also be used in GEODYN. The description follows the default model	K2 ampl/K2 phase/ K3 phase
7-8	I2	Indicates which tidal coefficient to be modified.	0

```
              VALUE            COEFFICIENT
               20              K2 amplitude
               21              K2 phase
               30              K3 amplitude

         A value of 0 sets all coefficients
         (K2 amplitude, K2 phase  and
          K3 amplitude) to zero.  [1]
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9-10	I2	A value of 1 means that the pole tide is applied to correct the station positions. (stations only)	0
25-44	D20.8	Value of tidal parameter being modified. Defaults:	

```
              COEFFICIENT      VALUE
              K2 amplitude     0.29                        0.29 [2]
              K2 phase         2.5 degrees                 2.5  [2] DEG
              K3 amplitude     0.0                         0.
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	Standard deviation of tidal coefficient. If non-zero value is specified, tidal parameter will be adjusted.	0.

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TIDES    2 0      2 00.30190           -0.00000      1.0                   1.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION
1-5	A5	TIDES - Description of the extended model
7-8	I2	Must be zero to assume the extended model.
11-12	I2	Forcing degree

```
13-14   I2      Forcing order

21-22   I2      Receiving degree

23-24   I2      Receiving order

25-44   D20.8   "A" coefficient.                          0.

45-59   D15.3   "B" coefficient.                          0.

60-72   D13.1   Sigma "A". [NOTE 3]                       0.

73-80   D8.2    Sigma "B". [NOTE 3]                       0.
```

NOTE [1]: It is sufficient to turn on the pole tide in one card (even if more
          TIDES option cards are included in the setup).

NOTE [2]: These default values apply only to earth tracking stations. In case
          of other planetary stations the default values are zero.

NOTE [3]: Convention for adjusting standard tides:
1. If there is no sigma on any TIDES card, there will be no adjustment
   of the standard tides.
2. If there is a sigma in one of the TIDES cards, GEODYN applies that sigma
   to the parameter, and all the other parameters will be assigned a sigma=
   1.D-20

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Default values given above are used, and pole tide will not
                  be applied.

2.3.108   TOLS

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TOLS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOLS - Requests changes in integration tolerances.	
11-14	I3	Maximum degree of geopotential used in computing the variational equations.	12 Except = maximum degree of geo-potential whenever E-matrix requested.

IF CARD OMITTED: Defaults apply.

2.3.109 TRKBDY

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TRKBDY     300
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   TRKBDY - Sets the planet number
                 of the tracking body , i.e. body
                 on which are located the tracking
                 stations.

11-14   I4   Indicates body number for the   0300
                         tracking body .

                         Body numbers are as follows:

                         0100   Mercury
                         0200   Venus
                         0300   Earth
                         0301   Earth's Moon
                         0400   Mars
                         0500   Jupiter
                         0600   Saturn
                         0700   Uranus
                         0800   Neptune
                         0900   Pluto
                         9999   Sun

UNITS: M =Meters   ; S =Seconds

IF CARD OMITTED: Then Earth (0300) is used as the tracking body .

2.3.110   TRPOUT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TRPOUT     300
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   TRPOUT - Requests estimation of tropospheric
                 biases. The estimated tropospheric biases
                 will be added to the original observation,
                 and the sum of the observation corrections.

                 The new osbservation and sum of observations
                 corrections will then be output on unit 20
                 on a GEODYN II binary data file. This option
                 works only with the presence of the global
                 option G2BOUT.

2.3.111   VLIGHT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
VLIGHT                                          299792500.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   VLIGHT - Modifies and/or requests
                   adjustment of speed of light.

25-44   D20.8   Current best value of speed of   299792458.   M/S
                   light.[NOTE 1] If = 0, value will
                   default to a priori speed of light.

45-59   D15.3   A priori value of speed of light.   299792458.   M/S
                   [NOTE 1]

60-72   D13.6   Standard deviation of speed of light.   0.   M/S
                   If greater than zero speed light will
                   be adjusted.

NOTES:

 [1]   Speed of light values will be checked for reasonableness
        and will be ignored if different from default value by more
        than 1 part per million.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD IS OMITTED: Default value will be used.

2.3.112 VECOPT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
VECOPT  5  40 10                  7000000.0                          20000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	VECOPT - Vector optimization and core allocation control option.	
7	I1	Controls vector optimization for the chaining of partials and the formation of the normal matrix.	0 if no EMATRX card, 2 if EMATRX card in setup.
		=0 Optimizes over the number of observations	
		>0 Optimizes over the number of estimated parameters.	
		>1 Forms normal matrix by partitions.[3]	
9-10	I2	Indicates number of scratch units available for storage of partials when normal matrix is formed by partitions. Limit of 20. First scratch unit will be 51. Subsequent scratch units will increment by one up to 70.	1
11-14	I4	Controls the maximum number of observations that will be used in one data block (minimum no. = 11 , maximum = 9999) [1,2].	1000 if no EMATRX card, 40 if EMATRX card in setup.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	Number of integration steps over which interpolation may be simultaneously performed. Must be greater than or equal to integration order minus one. Increasing this number allows more observations per block [2]. This is of particular advantage when MBIAS, PBIAS or EBIAS options are invoked along with local pass editing (see EDIT card column 7). This options consumes considerably more memory and is therefore disadvantageous	Integration order minus one [2].

```
                 to large E-Matrix generation runs.

25-44   D20.8   Maximum amount of memory available for 2E        7000000  64 bit
                job. For CRAY runs this would be the same          words
                amount of memory requested on your QSUB
                card. For Cyber runs 5100000 64 bit words
                is suggested.

73-80   F8.1    Number of blocks (of 512 64-bit words)            20000.
                of disk space requested for each normal
                matrix partitioned formation scratch file.

                A good estimate for the total disk space
                required for all of these scratch files
                may be obtained by multiplying the number
                of weighted observations plus twice the
                number of E-biases  by the number of
                adjusted parameters and dividing by 512.


        NOTES:

        [1]     The Tracking Data Formatter program outputs a maximum of 9999 obs.
                per block. GEODYN-IIS may reduce the number of observations in a
                block but not increase it. By reducing the number of observations
                in a block, memory requirements are decreased. This may be required
                when a large number of parameters are estimated.

        [2]     Values in columns 11-14 and 15-17 are automatically provided by NORMPT
                option.

        [3]     Partitioning is automatically requested for E-matrix runs regardless
                of the value indicated in column 7.



        IF CARD OMITTED: Default optimizations will be used.
```

2.3.113 XEPHEM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
XEPHEM 2   500              920324000000.          920325000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	XEPHEM - Indicates that an external ephemeris will be provided for use in the measurement model routines for determining the orbits. Note [1]	
7-8	I2	Number of satellite ephemerides provided on external ephemeris. The ID's for the satellites are included in the header record of the ephemeris file.	1
11-14	I4	Size of internal buffers used to hold the satellite ephemeris information. Note [2]	300
15-16	I2	Unit number for the file that contains the external ephemeris. This unit is read only in IIE. IIS does not verify that the file exists, nor does it verify that the file actually contains the number of satellites or time periods specified. IIE will terminate if the information is incorrect.	66
25-44	D20.8	Start time for the external ephemeris in the form: YYMMDDHHMMSS. Start time must be at least three time steps prior to the first observation point for the 10 point hermitian interpolation. NOTE [3]	
45-59	D15.3	End time for the external ephemeris in the form: YYMMDDHHMMSS. End time must be at least five time steps after the last observation for the 10 point hermitian interpolation. NOTE [3]	

Note [1]: The external ephemeris file contains a cartesian trajectory for
          some or all of the satellites in the run. All satellites in the
          run are still specified after the REFSYS card with each satellite
          requiring a SATPAR,an EPOCH and two ELEMS cards. A 10th order
          hermitian interpolator is used to interpolate the satellite
          trajectory to the epochs required for measurement modeling.

Note [2]: In most cases the coordinate system used for the trajectories on
          the external ephemeris file is the True of Date coordinate system
          associated with the central body with the origin at the center
          of mass of the central body. However starting with version
          1507.12, the XEPHEM option can be used to input and replace the
          trajectory of the central body when the INTGCB capability is
          being used. When the XEPHEM option is being used in conjunction
          with the INTCB option, the trajectory coordinate system is in the
          True of Reference coordinate system (usually J2000 Earth Equator

and Equinox) with the origin at the center of mass of the sun.

Note [3]: When using the XEPHEM option the user should remember that although
          GEODYN is using the input ephemeris for measurement modeling, the
          trajectory and associated force model partials are still being
          computed and folded into the normal equations, To avoid a degraded
          least square solution, all force model parameters associated with
          a satellite on the external ephemeris should be tightly constrained.

Note [4]: IIE uses a double buffering scheme where each buffer is
          (6 * No. of satellites * Buffer size) 64 bit words. In general, the
          larger the buffer the more efficient the run.

Note [5]: To determine the start time for the external ephemeris note
          that the integrator evaluates the first point 5 integration steps
          before the listed epoch time. The external ephemeris start time
          must be at least 3 time steps prior to this point. So, if the
          integration step size is Tstep, and the interval on the external
          ephemeris is Textint, then the external ephemeris start time must
          be less than Tstart - 5*Tstep - 3*Textint.
          To determine the stop time for the external ephemeris note
          that the integrator may go 2 integration steps beyond the epoch
          stop time. The external ephemeris stop time must be at least 5
          time steps after this point. So, if the integration step size is
          Tstep, and the interval on the external ephemeris is Textint,
          then the external ephemeris stop time must be greater than
          Tstop + 2*Tstep + 5*Textint.

IF CARD OMITTED: Satellite ephemeris is obtained from integration of orbit.

                        EXTERNAL EPHEMERIS

The external ephemeris file is a binary file consisting of a header
record and any number of data records. The total number of data records
is optional, but it must be sufficient to at least cover the data times
in the GEODYN run (+3 steps before the first data point and 5 steps
after the last data point for the 10 point hermitian interpolation).
Following is a description of the header and data records.

HEADER RECORD. (Record Length, RECL = 6*nsat+1)

Word(s)
1   - Number of satellite ephemerides in this file (nsat)
2   - Start time of ephemeris data in UTC yymmddhhmmss.
3   - Time interval between ephemeris points. (Step size)
4 -> nsat+3   - Satellite ID's of the satellites in this file in the
                   order that the satellite ephemeris data is provided
                   in the data records. (i.e. the first satellite ID
                   must belong to the first set of six satellite elements
                   in the data record)
nsat+4 -> RECL   - Set to zero. Not currently used.

DATA RECORDS. (Record Length, RECL = 6+nsat+1)

The time between data records must correspond exactly to the time
interval specified in word 3 of the header record. The satellite
elements provided in each data record must be in the same order as the
satellite ID's specified in the header record. The satellite elements
provided must be true of data cartesian elements.

```
        Word(s)
          1                  - Time in seconds from start time specified in
                               the header record.  For the first data record
                               this must be zero seconds.

        2 -> 7               - Six satellite elements for satellite number 1
              .
              .
6*(nsat-1)+2 -> 6*nsat+1 - Six satellite elements for satellite number nsat
```

2.3.114 YARKOV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
YARKOV
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

1-6   A6   YARKOV - Requests the computation and application of the Yarkovsky/ Schach effect on small spinning satellites such as LAGEOS and LAGEOS II

7   I1   Index for GEODYN "TYPE" of run

=0 GEODYN will do an ORBGEN and will produce a binary file (UNIT 67) containing the necessary shadowing information.

=1 Data reduction run where GEODYN will read UNIT 67 and will compute the Yarkovsky accellerations

8   I1   Index for model to be applied:

=0 Rapid spin case
=1 Slow rotating case

18-24   I7   Satellite ID

25-44   D20.8   The amplitude of the perturbative acceleration.

45-59   D15.3   Thermal relaxation time

2.3.115 YAWPOL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
YAWPOL 2   500            920324000000.          920325000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
		Introduces a group of option cards with Yaw polynomial information. This group may be used for GPS satellites in order to control the Yaw that GEODYN will compute. The end of the YAWPOL group is defined by the global card YPLEND.	
1-6	A6	YAWPOL - Following the blank YAWPOL card, the Yaw polynomial information cards, have the following format:	
1-7	I7	Satellite ID. NOTE [1]	
10-22	F13.1	ET start time.	SEC. from 2430000.5
24-36	F13.1	ET stop time.	SEC. from 2430000.5
39-49	F11.6	a0 of the quadratic polynomial	degrees
52-62	F11.6	a1 of the quadratic polynomial	degrees
65-76	F11.6	a2 of the quadratic polynomial	degrees
79	A1	It is important that column 79 be filled with the letters S, P or N. These are just comments but it helps GEODYN IIS realize that the card is a YAW polynomial card. NOTE [2]	
80	A1	1 - first half of maneuver 2 - second half of maneuver N - noon	

Note [1]: All polynomials should be grouped by satellite ID and time order.

Note [2]: Input to colums 79-80 are interpreted as follows:
         S1 = first half of shadow maneuver
         S2 = second half of shadow maneuver
         P1 = first post shadow maneuver (not always present)
         P2 = second post shadow maneuver (usually present)
         NN = Noon maneuver (only present for very low beta angles)

2.3.116 YAWRAT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
YAWRAT 2   500             920324000000.        920325000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	YAWRAT - Provide the maximum yaw rates, and yaw rate rates for each satellite in the GPSSHD group	
8-24	I7	Satellite ID.	
25-34	D20.5	Yaw rate value	deg/sec
24-36	F13.1	Yaw rate rate value	deg/sec2

2.3.117 YPLEND

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
YAWPOL 2   600            920324000000.        920325000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   YPLEND - Denotes the end of the YAWPOL
                       group.

IF CARD OMITTED: Abnormal termination.

2.3.118   POSITION CARD GROUP

2.3.118.1   STATION COORDINATE SUBGROUP

2.3.118.1.1 STAPOS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STAPOS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STAPOS - Introduces station position sub-group cards. The station position sub-group contains also optional station linear velocity information.	
7	I1	Coordinate system for adjustment of stations and indicator that all stations are to be adjusted except those explicitly excluded using the FIXED subgroup card.	0

= 0 Indicates no adjustment, or
      adjustment of individual stations
      will be indicated explicitly
      by use of ADJUSTED cards.

> 0 Indicates that all stations for which
      tracking data exists will be
      adjusted unless explicitly
      overridden by use of a FIXED card.
      (Columns 25-72 must be a non zero)

      Coordinate system for adjustment:
      = 1 Geodetic   - Phi,Lambda,Height
      = 2 Cartesian   - X,Y,Z
      = 3 Cylindrical   - S.A.D,Lambda,Z
      = 4 Spherical   - Phi,Lambda,R

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
8	I1	Station geodetic file indicator. (Default is for geodetics file to be read prior to reading station coordinates following this STAPOS card)	0

= 0 Indicates stations will be read from
      the station geodetic file on unit 16.

> 0 Indicates that no stations from the
      station geodetics file are to be used.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9	I1	> 0 Value in columns 73-80 overrides ELCUTOFF in Station Geodetics File and sets new default until overridden with ELCUTOFF following this card.	
11-14	I4	Maximum number of configurations which data is available in this run. [NOTE 1]	50
25-44	D20.8	Sigma for first station component as indicated by value in column 7.	0.

```
                         (must be a non zero if col 7>0)

45-59   D15.3     Sigma for second station component            0.
                  as indicated by value in column 7.
                  (must be a non zero if col 7>0)

60-72   D13.1     Sigma for third station component             0.
                  as indicated by value in column 7.
                  (must be a non zero if col 7>0)

73-80   D8.2      Elevation cutoff override of Station
                  Geodetics File (see column 9).



NOTES:
 [1]   A configuration in GEODYN II is defined as a unique combination of
       station-satellite-measurement type.



       The valid STAPOS subgroup cards are listed below

            ADJUSTED   -   Turns on station adjustment
            CORREL     -   Station correlations
            CONSTADJ   -   Start of constrained stations
            CONSTEND   -   End of constrained stations
            FIXED      -   Turns off station adjustment
            GEODETIC   -   Defines station geodetic information
            EXTRAGEO   -   Specifies planetary shape parameters
            ELCUTOFF   -   Sets station elevation cutoff angle
            INSTRMNT   -   Sets station antenna and operating frequency information
            STATION COORDINATE CARDS - Station positions
            STAVEL     -   Station velocities
            TIMVEL     -   Reference time for station velocities
            SIGVEL     -   Sigmas for adjusted station velocities
            STATL2     -   Station earth tide L2
            STATH2     -   Station earth tide H2
            ENDSTA     -   End of STAPOS subgroup

The format of all cards in the subgroup is as follows:

       A8,2I1,I2,I8,3D15.6,I5,10



There are two categories of stations:

1.     Those adjusted (i.e., those which follow an ADJUSTED card).

2.     Those not adjusted (i.e., those which follow a FIXED card).
       Within the set of stations which are adjusted there are those which are
       constrained to move together.  A set of stations constrained to move as
       a set can be defined as that set which is adjusted and which follows a
       CONSTADJ card and precedes either a CONSTEND card or a FIXED card or an
       ENDGLB card or the next CONSTADJ card.

The conditions stated on an ADJUSTED card or a FIXED card are imposed
until another ADJUSTED or FIXED card is encountered or an ENDSTA card is
```

encountered.

The conditions stated on a CORREL card apply only to adjusted stations and are imposed until another CORREL card is encountered. (Default correlations are zero).

The conditions stated on an ELCUTOFF card are imposed until another ELCUTOFF card is encountered. (Default - ELCUTOFF is zero degrees.)

The conditions stated on an INSTRMNT card are imposed until another INSTRMNT card is encountered.

The conditions stated on a GEODETIC card or an EXTRAGEO card are imposed until another GEODETIC or EXTRAGEO card is encountered.

Station Location cards follow the appropriate cards of other types necessary to specify the conditions that are to apply to those station locations.

Station Location cards without values in the location data fields imply that the location data is to be obtained from the Station Geodetics file but that the other conditions indicated by the preceding STAPOS Subgroup cards apply.

The STAPOS card can indicate the adjustment of all tracking stations not explicitly excluded by the FIXED card. This includes stations obtained from the Station Geodetics file if this file has not been specifically excluded. If the adjustment of all stations has been requested using the STAPOS card, then the ADJUSTED card may still be used to specify the conditions of adjustment of particular subgroups of station coordinates. Unless specified otherwise (using GEODETIC or EXTRAGEO) all stations are considered to be located on the earth (see Keyword Option Card EARTH).

Station velocity cards (STAVEL) should follow immediately the station location cards.

It is required that the station velocity group has the following sequence:

STATION POSITION CARD
STAVEL
TIMVEL
SIGVEL

If no velocity cards are present, GEODYN will apply zero velocities to the stations, therefore extra velocity parameters will appear in the GEODYN parameter summary printout.

Considering the station position and station velocity combinations, GEODYN will handle:

a.   Fixed positions/ fixed velocities
b.   Adjusted positions/ fixed velocities
c.   Fixed positions/ adjusted velocities
d.   Adjusted positions/ adjusted velocities

No correlations are provided for station velocities.

Extra attention should be given at a setup with constraint stations. The
station velocity cards in this case should follow immediately the master station
and not the constrained station (station with data).

Cards like ADJUSTED and FIXED do not affect station velocities. Only the
presence of SIGVEL controls the adjustment of station velocities.

The STATL2 (or STATH2) cards should follow the station velocity group cards
or if there are no velocity cards this card must follow the station coordinate
cards, for example:

STATION POSITION CARD
(STAVEL)
(TIMVEL)
(SIGVEL)
STATL2
STATH2

STATL2 and STATH2 cards are independent of each other. The user can apply or
or solve for L2 or H2 or both per station. If the STATL2 (or STATH2) card is not
present for an individual station the solid earth tide corrections for this
station will either use the value from the L2LOVE card (or H2LOVE) if they are
present or the default GEODYN value if they are not present.

2.3.118.1.2 ADJUSTED

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
ADJUSTED2          10.            10.                  10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	ADJUSTED - Requests adjustment of all stations following this card up to a FIXED or ENDSTA card.	
9	I1	Coordinate system for adjustment of station.	0

```
                      =  0   or 1      Phi,Lambda,Height
                      =  2             X,Y,Z
                      =  3             S.A.D.,Lambda,Z
                      =  4             Phi,Lambda,R
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
21-35	D15.6	Sigma Phi or Sigma X or Sigma S.A.D.	0. S or M
36-50	D15.6	Sigma Lambda or Sigma Y	0. S or M
51-65	D15.6	Sigma Height or Sigma Z or Sigma R	0. M

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds


IF CARD OMITTED:  Stations will not be adjusted unless adjustment of all
                  stations requested by inclusion of non-zero sigmas on
                  STAPOS card.
```

2.3.118.1.3 CONSTADJ

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONSTADJ
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-8   A8   Adjusted stations which follow this
                   card are constrained together.

                   CONSTADJ is negated by CONSTEND,
                   FIXED, next CONSTADJ or ENDSTA.

                   An ADJUSTED card must preceed
                   the CONSTADJ card.

IF CARD OMITTED: Stations will not be constrained.

2.3.118.1.4 CONSTEND

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONSTEND
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS FORMAT           DESCRIPTION                          DEFAULT VALUE & UNITS

1-8     A8      CONSTEND - Turns of constrained stations.
                Negates CONSTADJ card.



IF CARD OMITTED:   If a previous CONSTADJ card exists, then all stations
                   after CONSTADJ will be constrained.  If no CONSTADJ
                   card exists, this card is ignored.
```

2.3.118.1.5 CORREL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CORREL               .831                .917                .983
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	CORREL - Provides for correlations between station coordinate compon- ents. Uses the same coordinate system as specified on STAPOS or last ADJUSTED card.	
21-35	D15.6	Correlation between components 1 and 2.	0.
36-50	D15.6	Correlation between components 1 and 3.	0.
51-65	D15.6	Correlation between components 2 and 3.	0.

IF CARD OMITTED: No correlations between the station components exist.

2.3.118.1.6 ELCUTOFF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELCUTOFF          10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-8   A8   ELCUTOFF - Specifies elevation
                 angle below which data will auto-
                 matically be edited.

21-35   D15.6   Elevation cutoff angle.   0.   DEG

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Elevation cutoff of zero degrees is used.

2.3.118.1.7 EXTRAGEO

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EXTRAGEO        0300    6378145.0  298.255
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	EXTRAGEO - Specifies planetary shape parameters for stations which follow.	
17-20	I4	Planetary body number: Mercury 0100 Venus 0200 Earth 0300 Earth's Moon 0301 Mars 0400 Jupiter 0500 Saturn 0600 Uranus 0700 Neptune 0800 Pluto 0900 Sun 9999	0
21-35	D15.6	Semi-major axis for planet.	6378138. M
36-50	D15.6	Inverse of polar flattening of the planet.	298.255
51-65	D15.6	Inverse of equatorial flattening of the planet.	0.

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED: Default values for earth apply.

2.3.118.1.8 FIXED

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FIXED
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-8   A8   FIXED - Used to indicate that for the
                stations that follow this card there will
                be no adjustment. This card is used to
                negate adjustment requests by either the
                STAPOS or ADJUSTED cards.

                To negate the FIXED card another ADJUSTED
                card may be used.

IF CARD IS OMITTED: No negation of adjustment will occur.

2.3.118.1.9 GEODETIC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GEODETIC          6378145.0      298.255
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	GEODETIC - Specifies Earth ellipsoid parameters for stations which follow.	
21-35	D15.6	Earth semi-major axis in meters. [NOTE 1]	0. M
36-50	D15.6	Inverse of the flattening (1/f) of the earth. [NOTE 1]	0.

NOTES:

 [1]   Defaults will be obtained in the following order:

        Default values built into GEODYN IIS
        Values obtained from Gravity Model File
        Values obtained from EARTH card
        Values from GEODETIC card

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Default values from gravity file on UNIT 12 or from an
                  earth option card will apply.

2.3.118.1.10 INSTRMNT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
INSTRMNT 3          1.0           0.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT          DESCRIPTION                   DEFAULT VALUE & UNITS


1-8      A8      INSTRMNT - Specifies tracking
                 instrument parameters.


9-10     I2      Antena number (If ANTPHC option has              0
                 been invoked)
                 GEODYN will use the antenna number
                 which have been provided on unit 22.


                         otherwise


                 Antenna mount type. (If ANTPHC option            3
                 has NOT been invoked)


                  =1  X-Y East-West
                  =2  X-Y North- South
                  =3  Azimuth-Elevation
                  =4  Hour Angle-Declination
                  =5  Richmond VLBI Antenna Mount
                  =6  Displacement applied to
                      station height
                  =7  Station height read from
                      unit 23 [NOTE 2]
                  =8  Pressure changes read from
                      unit 23 [NOTE 3]

13-16    I4      Laser Tracking Station Detector Type             1

                 MCP Stations:
                  =1  Wuhan
                  =2  Wettzell
                      Tokyo
                  =3  MOBLAS-5 (Yarragadee)
                      HOLLAS   (Haleakala, HI)
                      TLRS-4
                  =4  MOBLAS-4 (Monument Peak, CA)
                      MOBLAS-8 (Quincy, CA)
                      TLRS-3
                      MLRS     (FT. Davis, TX)
                  =5  MOBLAS-7 (Greenbelt, MD)
                  =6  TLRS-1
                  =7  TLRS-2
                  =8  Bar Giyyora
                  =9  Orroral
                      MTLRS-2

                 PMT Stations:
                  =10 Herstmonceux
                  =11 Zimmerwald
                      Borowiec, Poland
                  =12 Grasse
                  =13 Shanghai
```

```
                          San Fernando , Spain
               =14 MTLRS -1
               =15 Helwan
               =16 Beijing
               =17 Chang Chun
                          Katsively , Ukraine
                          Riga , Latvia
               =18 Postsdam
                          Dunaovcy , Ukraine
                          Maidanak , Uzbekistan
                          Evpatoria , Ukraine
                          Komsomolsk , Russia
                          Balkash , Russia
                          Simeiz , Ukraine
               =19 Santiago , Cuba
                          Metsahovi , Finland

               SPAD  Stations:
                =20 Herstmonceux
                          Graz
                          Simosato
                          MTLRS -1
                          FTLRS

               Matera Station:
                =21 Matera

21-35   D15.6  Antenna axis displacement in meters.              0.           M

36-50   D15.6  Nominal received wavelength in microns.           0.    M*1.0D-6
               ( 0. indicates nominal wavelength will
                 be used from observation file as
                 supplied by the Tracking Data
                 Formatter Program.)

51-65   D15.6  Turn around factor (TRF).                         1.
               (TRF=Wavelength trans./wavelength rec.)
```

NOTES :

    [1]   Inclusion of an INSTRMNT card which is blank except for columns 1-8 negates any previous INSTRMNT card and reverts back to the station complement defaults.

    [2]   A "7" in column 10 requests reading the station height offsets from unit 23. The following quantities are read:

```
          Col
          1-6      IYMD       I6       - year , month , day (YYMMDD)
          7-10     IHM        I4       - hour , minute (HHMM)
          11-20    SEC        F10.1    - seconds
          21-22                        - not used
          23-30    NSTA       I8       - station number
          36-59    AOFF       D24.16   - height offset
```

If the file connected to unit 23 is not present or is empty, no station

height offsets are applied. Otherwise, the station height offset is
chosen as the value on the record whose time is less than or equal to
the current time. A time before the start of the table takes the
value of the first offset for that station; a time after the end of
the table takes the last value in the table.

[3] A "8" in column 10 requests reading the station pressure values from
unit 23. The following quantities are read:

```
 Col
 1-6      IYMD       I6        - year, month, day (YYMMDD)
 7-10     IHM        I4        - hour, minute (HHMM)
11-20     SEC        F10.1     - seconds
21-22                          - not used
23-30     NSTA       I8        - station number
36-59     pmean      D24.16    - pressure offset (mbar)
60-83     scale                - pressure scale factor
```

The reading of unit 23 and the assignment of values is done as for
option 7. (See NOTE [2] above)

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD IS OMITTED: No instrument correction will be applied.

2.3.118.1.11   STATH2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STATH2
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   STATH2 - Requests application or
                  estimation of solid earth tide
                  coefficient of the second kind for
                  this station only

13-20   I8   Station number

21-35   D15.6   A priori value of the coefficient   value from
                                                                H2LOVE

36-50   D15.6   Sigma of the coefficient. If this
                  field is zero the coefficient will
                  not be estimated.

NOTE: A STATH2 card must follow the station velocity card group, or
         if there are no velocity cards this card must follow the
         station coordinate card, if solid earth tide of the second kind
         correction, other than the one specified on the H2LOVE card is
         to be applied.

IF CARD OMITTED: Earth tide for the preceeding station will be applied
                   using the coefficient from the H2LOVE card. If H2LOVE
                   card is not present GEODYN will use the default value.

2.3.118.1.12 STATL2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STATL2
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT        DESCRIPTION                       DEFAULT VALUE & UNITS

1-6     A6      STATL2 - Requests application or
                estimation of solid earth tide
                coefficient of the third kind for
                this station only

13-20   I8      Station number

21-35   D15.6   A priori value of the coefficient          value from
                                                            L2LOVE

36-50   D15.6   Sigma of the coefficient. If this
                field is zero the coefficient will
                not be estimated.



NOTE:    A STATL2 card must follow the station velocity card group, or
         if there are no velocity cards this card must follow the
         station coordinate card, if solid earth tide of the third kind
         correction, other than the one specified on the L2LOVE card is
         to be applied.


IF CARD OMITTED:   Earth tide for the preceeding station will be applied
                   using the coefficient from the L2LOVE card.  If L2LOVE
                   card is not present GEODYN will use the default value.
```

2.3.118.1.13   STATION COORDINATE CARDS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STALAS      000070631130719.3758    -4831370.1542    3994089.0480
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	Station name.	no default
9	I1	Coordinate system indicator:	0

          = 0   GEODYN will determine if input
             is geodetic or cartesian.

          = 1   Geodetic   - Phi,Lambda,Height
          = 2   Cartesian   - X,Y,Z
          = 3   Cylindrical - S.A.D,Lambda,Z
          = 4   Spherical   - Phi,Lambda,R   N / A

10 I1 Net Constraints Index =0 : No participation
         =1 : The station participates in net translation
            =2 : The station participates in net rotation
         =3 : The station participates in both

COLUMNS	FORMAT	DESCRIPTION	DEFAULT
11-12	I2	< 99 is Plate number. = 99 apply thermal deformation for antenna	0
13-20	I8	Station number.	0
21-35	D15.6	First coordinate: (+ or -)DDMMSS.SSS (+ or -)XXXXXXX.XXX meters	0.
36-50	D15.6	Second coordinate: DDDMMSS.SSS (+ or -)XXXXXXX.XXX meters	0.
51-65	D15.6	Third coordinate: (+ or -) XXXXXXX.XXX meters	0.
67-70	I4	Site number only for stations involved in ocean loading (same as in columns 13-20)	0
71-80	A10	Available for comments.	

IF CARD OMITTED: Stations coordinates will be obtained from geodetic
                file on UNIT 16.

2.3.118.1.14 STAVEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STAVEL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS	
1-6	A6	STAVEL: Introduces station velocities in a 3-D Cartesian coordinate system.		
13-20	I8	Station number		
21-35	D15.6	First component of velocity	0	M/S
36-50	D15.6	Second component of velocity	0	M/S
51-65	D15.6	Third component of velocity	0	M/S

NOTE : A STAVEL card must follow the equivalent station coordinate card if
        velocities other than zero are to be applied.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        H =Hertz   ; MH =Mega-Hertz; YR=Years

IF CARD OMITTED: Station velocities for the preceeding stations are assumed to
                  be zero.

2.3.118.1.15 TIMVEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TIMVEL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   TIMVEL: Introduces a reference time
                for the station velocities.

13-20   I8   Station number

21-35   D15.6   Reference time in YYMMDD.   EPOCH START TIME

NOTE :   A TIMVEL card corresponding to a certain station should follow
          its station coordinate and STAVEL card.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        H =Hertz   ; MH =Mega-Hertz;

IF CARD OMITTED: And station velocities have been already introduced by the
                  STAVEL card, EPOCH start time is considered to be reference
                  time.

2.3.118.1.16 SIGVEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIGVEL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SIGVEL: Requests adjustment of the
                 velocities for the preceeding station.

13-20   I8   Station number

21-35   D15.6   Sigma for the first velocity component   0   M/S

36-50   D15.6   Sigma for the second velocity component   0   M/S

51-65   D15.6   Sigma for the third velocity component   0   M/S

NOTE :   A SIGVEL card must follow the equivalent STAVEL and TIMVEL card if
         velocity adjustment for the preceeding station is requested.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second
        H =Hertz   ; MH =Mega-Hertz; YR=years

IF CARD OMITTED: Velocities will be applied on the preceeding station but no
                  velocity adjustment will take place.

2.3.118.1.17 ENDSTA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDSTA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION

1-8     A8      ENDSTA - Ends STAPOS Subgroup.
                This card is required if a STAPOS
                card is present.



IF CARD OMITTED: Run will terminate if a STAPOS card is present and no
                 ENDSTA card is included
```

2.3.118.2   QUASAR COORDINATE SUBGROUP

2.3.118.2.1 QUAPOS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
QUAPOS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	QUAPOS - Introduces quasar position sub-group cards.	

IF CARD OMITTED: VLBI data processing will abnormally terminate.

2.3.118.2.2 QUASAR COORDINATE CARD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
0016+731    4000                   01945.786329   732730.01803        0.015  0.020
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-8   A8   Quasar name

9-16   I8   Quasar ID

20 I1 Net Constraints Index   =0 : No participation
                  =1 : The quasar participates in net rotation

25-44   D20.8   Quasar right ascension   HHMMSS.SSSSSS

45-59   D15.3   Quasar declination   +/- DDMMSS.SSSS

60-72   D13.1   Quasar right ascension sigma   seconds

73-80   D8.2   Quasar declination sigma   arc seconds

IF CARD OMITTED: VLBI data processing will abnormally terminate
```

2.3.118.2.3 ENDQUA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDQUA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6             ENDQUA - Denotes the end of Quasar
                               coordinate subgroup


IF CARD OMITTED:  VLBI data processing will abnormally terminate.
```

2.3.119 GLOBAL SET TERMINATOR

2.3.119.1 ENDGLB

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDGLB
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

1-6   A6   ENDGLB - Indicates the end of the
                  global set option cards. This card
                  is MANDATORY in all runs.

7-8   I2   Convergence criteria for the global   02   %
                  iterations in percent. [NOTE 1]

9   I1   Minimum number of global iterations.   1

10   I1   Maximum number of global iterations   1

NOTES:

 [1]   Global convergence is defined as follows:

         ABS(RMS P - RMS C)/RMS C * 100 .LE. Convergence Criteria

         Where:

            RMS P = RMS previous global iteration
            RMS C = RMS current global iteration
            .LE. = Less than or equal

         On the first global iteration the value for the previous RMS
         is defaulted to 1000.

IF CARD OMITTED: Run will abnormally terminate.

2.4   ARC SET MANDATORY CARDS

2.4.1 ARC SET MANDATORY OVERVIEW

The ARC mandatory section includes three lines for the user to provide appropriate comments about the ARC, a REFSYS line to establish the inertial coordinate system that will be used for satellite orbit integration, a SATPAR line to define the satellite ID and cross sectional area and mass, an EPOCH line to define the epoch time for the satellite elements, and an ELEMS1 and ELEMS2 line to define the satellite elements.

The first eight lines of the ARC Set for each arc must be in the specific order shown below:

```
Arc title 1
Arc title 2
Arc title 3
REFSYS
SATPAR        --
EPOCH          | These four lines are repeated for
ELEMS1         |  each satellite in the arc
ELEMS2        --
```

If more than one satellite is used in an arc than the last four lines are repeated (SATPAR, EPOCH, ELEMS1 ELEMS2) for each satellite.

2.4.2 TITLE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
USER SPECIFIED JOB DESCRIPTION - CARD 1
USER SPECIFIED JOB DESCRIPTION - CARD 2
USER SPECIFIED JOB DESCRIPTION - CARD 3
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-80   10A8   User may specify on these three cards,
                   information description of the arc.
                   These cards may also remain blank, but
                   must always be present.

IF CARDS OMITTED: Run will abnormally terminate.

2.4.3 REFSYS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
REFSYS 2          830901000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	REFSYS - Specifies the coordinate system of integration and the number of arc iterations.	
7-8	I2	Maximum number of arc iterations during the first global iteration.	1
9	I1	Minimum number of arc iterations during the first global iteration.	1
10	I1	Maximum number of arc iterations during global iterations after the first.	1
11	I1	Coordinate reference system 0 True of reference date and time 1 Mean of J2000 [1]	0
21-26	I6	Year,month,day of reference date (YYMMDD).	0
27-30	I4	Hour,minute of reference time (HHMM).	0
31-40	D10.8	Seconds of reference time (SS.SSSSSSS).	0.

NOTE:

[1] The DE200 Ephemeris is needed when the J2000 reference system
     is selected. No reference date is needed in cols. 21-40 if
     J2000 is selected.

IF CARD OMITTED: Run will abnormally terminate.

2.4.4 SATPAR

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SATPAR          76039010.28274              411.000
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT       DESCRIPTION                       DEFAULT VALUE & UNITS
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SATPAR - Specifies spacecraft identi- fication number (Satellite ID), cross sectional area and mass. Also specifies maximum degree of gravitational coefficients to be considered significant for this spacecraft.	

7	I1	0 - Obtain average S/C cross sectional
		    area and S/C mass from columns
		    25-59 of this card.
		1 - Obtain same from S/C parameters
		    file.
			0

8	I1	0 - No tables of S/C cross section or :
		    solar radiation to be obtained :
		    from S/C parameter file. :
		1 - Only drag cross section tables :
		    used from S/C parameter file. :
		2 - Only solar radiation tables used :
		    from S/C parameters file. :
		3 - Both drag cross section and solar :
		    radiation tables used from S/C :
		    parameters file. :
			0
			
			N/A

9	I1	Twelve parameter state combination identifier. If this index is present there must be one more SATPAR card in the unit 5 setup to form the pair. For the fisrt satellite the index must be 1 and for the second 2. For the satellites forming a pair with these indices on col. 9, the following ELEMS1 and ELEMS2 cards contain 6 (six) each of the twelve state vector combination parameters. The first SATPAR with the index 1 is followed by ELEMS cards featuring the mid-point parameters, and the second SATPAR is followed by ELEMS cards featuring baseline parameters (Ref. NOTE [2]). Any following VARCOV cards for these two satellites feature the sigmas of the 12 state combination parameters.	
10-11	I2	Spacecraft attitude control algorithm 0 - Cannonball(no attitude control) 2 - TOPEX/Poseidon 3 - SPOT-2 4 - GPS 5 - ERS-1	0

```
                         6 - Mars Observer Mapping Phase
                         7 - Mars Observer Cruise Phase
                         8 - TDRSS
                         9 - Magnetically stabilized S/C
                         10 - GFO
                         11 - TRMM
                         12 - EUVE
                         13 - ICESAT
                         14 - ENVISAT
                         15 - CRYOSAT-2
                         16 - Leading GRAIL satellite
                         17 - Trailing GRAIL satellite
                         18 - HY2A
                         19 - SARAL
                         20 - SENTINEL


12      I1         Requests external attitude for this
                   satellite:                                   0
                    0 - No external attitude
                    9 - External attitude (See Volume 5
                        for a description of the external
                        attitude file)


13      I1         Local gravity application switch:    :       0
                    0 - Consider gravity anomaly, surface:
                        density and geoid height local   :
                        gravity terms to be significant  :      N/A
                        for this spacecraft.             :
                    1 - Consider local gravity terms to  :
                        be insignificant for this        :
                        spacecraft.                      :


14      I1         Requests external thermal acceleration
                   for this satellite:                          0
                    0 - No external thermal acceleration
                    1 - External thermal acceleration (See
                        Volume 5 for a description of the
                        external acceleration file)


15-17   I3         Maximum degree of gravitational coefficients   Max. of Model
                   to be considered significant for this S/C.


18-24   I7         Satellite ID (satellite ID is required).      0


25-44   D20.8      S/C cross sectional area.                  See col. 7    M**2


45-59   D15.3      S/C mass.                                  See col. 7    Kg


UNITS:  KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees    ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds


NOTES:
 [1]      If more than one satellite is used in an arc than the four lines
          SATPAR, EPOCH, ELEMS1 ELEMS2 - are repeated for each satellite.


          SATPAR           --
          EPOCH             | These four lines are repeated for
          ELEMS1            |   each satellite in the arc
```

```
        ELEMS2          --
```

[2]   A full description for the baseline representation of the
        initial epoch state parameters may be found in the following
        reference:
        "Short-arc analysis of intersatellite tracking data in a gravity
        mapping mission", D.D.Rowlands, R.D.Ray, D.S.Chinn, F.G.Lemoine,
        Journal of Geodesy (2002)76:307-316

IF CARD OMITTED: Run will abnormally terminate

2.4.5 EPOCH

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+---8
EPOCH                   830901                  830901                  830903
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EPOCH - Specifies epoch time for satellite elements ,optional start time for orbit integration ,and mandatory stop time for the run. The stop time is used by GEODYN to determine ephemeris and flux data requirements.	
21-26	I6	Year , month and day of epoch (YYMMDD).	0
27-30	I4	Hours and minutes of epoch (HHMM).	0
31-40	D10.8	Seconds of epoch (SS.SSSSSSS).	0.
41-46	I6	YYMMDD of start. : Default is epoch time.	cols. 21-26
		: If specified as other	
47-50	I4	HHMM of start. : than epoch, orbit will	cols. 27-30
		: be integrated to this	
51-60	D10.8	Seconds of start.: time and epoch reset	cols. 31-40
		: to this time before any	
		: measurement processing.	
61-66	I6	YYMMDD of stop. : A STOP TIME IS	0
		:	
67-70	I4	HHMM of stop. : MANDATORY	0
		:	
71-80	D10.8	Seconds of stop. : FOR ALL ARCS	0.

NOTE: All times specified on the ORBTVU and the ORBFIL card must fall
between the start time and the stop time specified on the EPOCH card.

2.4.6 SLAVE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
SLAVE                   7603901
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	SLAVE - Used in place of EPOCH card to indicate that this satellite belongs to a set of satellites.	
24-30	I7	Satellite ID of Master Satellite for this set. The Master Satellite must exist and the SATPAR,EPOCH,ELEMS1,AND ELEMS2 cards for the Master Satellite must have been defined prior to any SATPAR,SLAVE,ELEMS1, and ELEMS2 cards for a set. See discussion of slave satellites below.	

2.4.7   ELEMS1

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELEMS1              8986390.0780         8283790.5802        -1502498.2249
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ELEMS1 - Introduces the first three components of the orbital elements for the S/C.	
7	I1	Form of elements 0 - Either Cartesian or Keplerian 1 - Cartesian 2 - Keplerian 3 - Non-singular Keplerian 5 - Cartesian non-elliptic 6 - Keplerian non-elliptic	0
8	I1	Coordinate system of input elements NOTE(2)	0
11-14	I4	Central body for input elements. 0100 - Mercury 0200 - Venus 0300 - Earth 0301 - Earth's moon 0400 - Mars 0500 - Jupiter 0600 - Saturn 0700 - Uranus 0800 - Neptune 0900 - Pluto 9999 - Sun	300

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
21-40	D20.14	Element 1 see Table on next page	0 M
41-60	D20.14	Element 2 see Table on next page	0 M or none
61-80	D20.14	Element 3 see Table on next page	0 M, DEG or none

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

NOTE: [1] GEODYN II expects the elements to be refered to the IAU system
          regardless of which planet the S/C is orbiting about.

NOTE: [2] The coordinate system of input elements should be the same system

as specified on column 11 of the REFSYS option.

2.4.8   ELEMS2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELEMS2             849.44502691749      -1854.4317908133     -5301.4527479779
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT	VALUE & UNITS
1-6	A6	ELEMS2 - Introduces the second three components of the orbital elements for the S/C.		
21-40	D20.14	Element 4 see Table below	0	M/S, DEG or none
41-60	D20.14	Element 5 see Table below	0	M/S, DEG or none
61-80	D20.14	Element 6 see Table below	0	M/S or DEG

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

ELEMENTS DEFINITION

	INERTIAL CARTESIAN ELEMENTS	OSCULATING KEPLERIAN ELEMENTS	NON SINGULAR KEPLERIAN ELEMENTS
Element 1	x (meters)	A (meters)	A (meters)
Element 2	y (meters)	E	E*cos(w+OMEGA)
Element 3	z (meters)	I (degrees)	E*sin(w+OMEGA)
Element 4	x (meters/sec)	OMEGA (degrees)	sin(I/2)*sin(OMEGA)
Element 5	y (meters/sec)	w (degrees)	sin(I/2)*cos(OMEGA)
Element 6	z (meters/sec)	M (degrees)	M+w+OMEGA (degrees)

```
NOTE: [1] GEODYN II expects the elements to be refered to the IAU system
          regardless of which planet the S/C is orbiting about.
```

2.5 ARC SET OPTION CARDS

2.5.1 ACCELERATION SUBGROUP

2.5.1.1 ACCEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCEL 30        7603901             1.80D-12
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCEL - Requests application and/or adjustment of general acceleration.	

7	I1	Acceleration type
		  1 - Radial (R)
		  2 - Crosstrack (R x V)
		  3 - Alongtrack (V)
		  4 - In - plane (X axis)
		  5 - GPS X BIAS (along GPS X-axis)
		  6 - GPS Y BIAS (along GPS Y-axis)
		  7 - GPS Z BIAS (along GPS Z-axis)
			0

8	I1	Indicates order of acceleration coefficients
		
		  0 - Ga
		    .
		  1 - Ga
		    ..
		  2 - Ga
			0

18-24	I7	Satellite ID (required).	0
25-44	D20.8	A priori value of acceleration coefficients.	0. M/S**2 or M/S**3 or M/S**4

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	This field must be left blank unless the time dependent acceleration option is wanted. To select time dependent acceleration the end time of the period for which this acceleration coefficient applies is input in the form YYMMDDHHMMSS.SS in this field. See NOTE[1] for more details.	0.
60-72	D13.1	A priori sigma of acceleration coefficient.	0. M/S**2 or M/S**3 or M/S**4

NOTE[1]:
        Time periods may be specified only for the highest order coefficients
        used (i.e. if Ga and Ga dot are used, only Ga dot can have time
        intervals). When using time periods the number of ACCEL cards
        required is equal to the number of time periods plus the order (order
        = the number in column 8 +1). The Ga, Ga dot, and/or Ga double dot
        without a time interval are used for times beyond the end of the
        the last interval specified on the ACCEL cards. See following
        example.

261

```
  EXAMPLE:   ACCEL cards for time dependent general accelerations
            (highest order - Ga ;three time intervals;  4 cards required)


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCEL 30         7603901               1.80D-12
ACCEL 30         7603901               1.82D-12 840901000000.
ACCEL 30         7603901               1.84D-12 840902000000.
ACCEL 30         7603901               1.86D-12 840903000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


UNITS:   KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds



WARNINGS: If duplicate time periods are specified the run will terminate
          in IIS with a warning message.
          The first time period that exceeds the end time of the run
          (see EPOCH card) will be accepted. All other end times exceeding
          the end time of the run will be ignored.



IF CARD OMITTED: General accelerations are not applied
```

2.5.1.2   ACCLRM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCLRM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ACCLRM - Introduces the accelerometer
                         data group. Options included in this
                         group are ACCBIA and DYNSEL The option
                         ACCEND denotes the end of the
                         accelerometer data group.

25-44   D20.8   Time tolerance for matching extarnal   S
                         acceleration file times with interation
                         times. This optio is used with the dynamic
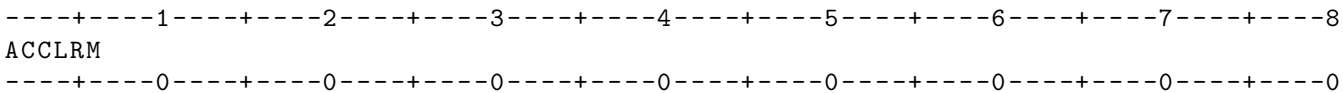   acceleration mode (DYNSEL)

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: and other accelerometer related options are on IIS will
terminate abnormally

2.5.1.3 AXES

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
AXES     9   9
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   AXES: allows the user to manipulate the way
                       input values from the accelerometer are used in GEODYN
                       The program ingests X, Y & Z accelerometer components
                       both in geometric and dynamic modes

                       columns 7-9 are used to denote which axes will be used
                       in GEODYN for dynamic accelerometry

                       columns 10-12 are used to allow the change of the sign
                       of accelerometry components in the dynamic mode

                       columns 13-15 are used to allow the change of the sign
                       of accelerometry components in the geometric mode

7   I1   =0 The X component of accelerometry   0
                           will replace the geodyn computed
                       =9 The X component of accelerometry
                           will not replace the geodyn computed

8   I1   =0   same as above for Y component   0
                       =9

9   I1   =0   same as above for Z component   0
                       =9

10-12   3I1   =9 changes the sign implied by the GFZ document   0
                          for X,Y or Z axis for dynamic accelerometry
                       =0 does not change the sign

13-15   3I1   =9 changes the sign implied by the GFZ document   0
                          for X, Y or Z axis for geometric accelerometry
                       =0 does not change the sign

NOTE:
A 9 in column 9 of the AXES card will delete Z axis for dynamic accelerometry.

A 9 in column 14 would cause the Y axis to have the opposite sign
from the sign implied by the GFZ document for geometric accelerometry.

IF CARD OMITTED: The axes will have the signs implied by GFZ document.

2.5.1.4 ACCBIA(UP TO 0407.00)

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCBIA121      2000039      000807000000.00000808000000.00 -7.21444D-06 1.0D-25
                                 5635.00
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBIA: Requests application and/or adjustment of accelerometer data biases	
7	I1	Type of Bias 1 - Absolute Bias 2 - Scale Bias 3 - Timing Bias	
8	I1	Component of Bias 1 - Total acceleration 2 - X component 3 - Y component 4 - Z component	
9	I1	Order of Bias 1 - Constant 2 - Linear 3 - Quadratic 4 - Periodic (sinwt) 5 - Periodic (coswt)	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for the accelerometer bias	YYMMDDHHMMSS.SS
45-59	D15.3	End time for the accelerometer bias	YYMMDDHHMMSS.SS
60-72	D13.1	A priori value of accelerometer bias	0.
73-80	D8.2	A priori sigma of accelerometer bias	1.D-25

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	6X	BLANKS must be present	
25-44	D20.8	Period for the two periodic terms in the model associated with the time interval specified on the previous card.	S

NOTE [1] The times on the ACCBIA cards should be input in advanced time order
         for each satellite. If the time order is not observed, GEODYN IIS
         will terminate abnormally.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms

```
          DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED: If the ACCBIA card is omitted, no biases will be applied to the
                accelerometer data. If the ACCBIA card is present, but the
                second BLANK card is missing the program will terminate
                abnormally.

2.5.1.5 ACCBIA(0407.01 AND BEYOND)

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCBIA121       2012001       30702      0.00 30702 30000.00
ACCBI2                   -.11276023375774D-05    0.5655D+04              0.10D+02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBIA: Requests application and/or adjustment of accelerometer data biases	
7	I1	Type of Bias	
		1 - Absolute Bias 2 - Scale Bias 3 - Timing Bias	
8	I1	Component of Bias	
		1 - Total acceleration 2 - X component 3 - Y component 4 - Z component	
9	I1	Order of Bias	
		1 - Constant 2 - Linear 3 - Quadratic 4 - Periodic (sinwt) 5 - Periodic (coswt)	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for the accelerometer bias	YYMMDDHHMMSS.SS
45-59	D15.3	End time for the accelerometer bias	YYMMDDHHMMSS.SS

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBI2	
25-44	D20.1	A priori value of accelerometer bias	0.
45-59	D15.3	Period for the two periodic terms in the model associated with the time interval specified on the previous card.	S
73-80	D8.2	A priori sigma of accelerometer bias	1.D-25

NOTE [1] The times on the ACCBIA cards should be input in advanced time order
         for each satellite. If the time order is not observed, GEODYN IIS
         will terminate abnormally.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If the ACCBIA card is omitted, no biases will be applied to the accelerometer data. If the ACCBIA card is present, but the second BLANK card is missing the program will terminate abnormally.

2.5.1.6 DYNSEL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DYNSEL            2000039      000807000037.00000808000000.00
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DYNSEL - Defines the times for which GEODYN will use external accelerations to drive the satellite. During these any accelerometer biases or attitude parameters become force model parameters.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for using external accelerometer data	YYMMDDHHMMSS.SS
45-59	D15.3	End time for using external accelerometer data.	YYMMDDHHMMSS.SS

IF CARD OMITTED: The satellite will be integrated as usual and there will be
                    no external acceleration contribution.

2.5.1.7 SURFRC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SURFRC1111111   2000039
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	During dynamic accelerometry periods, accelerations from the external acceleration file are added to the accelerations that GEODYN computes for a satellite. Usually, the accelerations on the external acceleration file come from an accelerometer on board the satellite. Accelerometers measure forces that act on the surface of a satellite (like solar radiation and atmospheric drag). During periods of dynamic acceleration, the SURFRC card allows a user to prevent the surface forces that GEODYN usually computes from internal models from the being added to the total satellite acceleration. This prevents double counting of forces during dynamic acceleration periods.	
		When there is a "1" in any of the columns from 7-13, during periods of dynamic acceleration GEODYN will not add the acceleration from the internal model associated with that force to the total satellite acceleration.	
7	I1	Index for General Acceleration	
8	I1	Index for Drag	
9	I1	Index for Solar Radiation	
10	I1	Index for Albedo	
11	I1	Index for Topex Thermal Radiation.	
12	I1	Index for Topex Louver Forces	
13	I1	Lageos Thermal Drag	
18-24	I7	Satellite ID	

NOTE: THE SURFRC cards should always be the last in the group before the
       ENDACC option

IF CARD OMITTED: During dynamic acceleration periods, all surface accelerations
                 computed from GEODYN internal models will be added to the
                 total satellite acceleration.

2.5.1.8 ENDACC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDACC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ENDACC - Denotes the end of the
                       accelerometer date sub-group

2.5.2 ACCELT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCELT3          7603901              1.80D-12
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCELT - Requests application and/or adjustment of general accelerations in three dimensions. This is a special option that may be used to simulate thrusting by applying accelerations in the alongtrack, crosstrack and radial directions at the same time. SPECIAL CARE is required in using this option because the input must be in a very specific order. (See the sample setup)	
7	I1	Acceleration type 1 - Radial 2 - Crosstrack 3 - Alongtrack	0
18-24	I7	Satellite ID (required).	0
25-44	D20.8	A priori value of acceleration.	0. M/S**2
45-59	D15.3	End time of the period for which this acceleration coefficient applies in the form YYMMDDHHMMSS.SS	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
60-72	D13.1	A priori sigma of acceleration coefficient.	0. M/S**2 or M/S**3 or M/S**4

NOTES:

  [1]   This option is not user friendly. The input cards must be in the
           order shown in the example on the next page. All of the cards
           pertaining to the alongtrack acceleration come first, followed by the
           cards pertaining to the crosstrack acceleration, followed by the
           cards pertaining to the radial accelerations. The times on the
           alongtrack cards are the only times that are used, however,
           times are required on the crosstrack and radial cards.
           The times must be in ascending order and all times specified must be
           within the run times specified on the EPOCH card or GEODYN IIS will
           throw them out.

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

 IF CARD OMITTED: General accelerations are not applied.

                        Sample ACCELT Setup

        Following is a set of ACCELT cards used to apply two
thrusting type of accelerations (thrusting in the sense that the
accelerations are zero prior to and after the acceleration interval).


```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCELT3          7603901              0.0

ACCELT3          7603901              0.0        911007020000.00
ACCELT3          7603901              1.000E-06911007020200.00
ACCELT3          7603901              0.0        911007040000.00
ACCELT3          7603901              1.000E-06911007040200.00
ACCELT3          7603901              0.0        911007060000.00

ACCELT2          7603901              0.0        911017020000.00
ACCELT2          7603901              1.000E-06911017020200.00
ACCELT2          7603901              0.0        911017040000.00
ACCELT2          7603901              1.000E-06911017040200.00
ACCELT2          7603901              0.0        911017060000.00

ACCELT1          7603901              0.0        911027020000.00
ACCELT1          7603901              1.000E-06911027020200.00
ACCELT1          7603901              0.0        911027040000.00
ACCELT1          7603901              1.000E-06911027040200.00
ACCELT1          7603901              0.0        911027060000.00
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```


        Notice that the first card does not have a time period specified
and that the times for the crosstrack (2) and radial (1) cards have been
increased by 10 days. This will require that the end time specified on
the EPOCH card be 20 days later.
        Note that when this option is used, GEODYN IIE will print the
thrusting acceleration vector in m/(sec**2) at integration steps where
the thrusting vector has a magnitude of larger than 1.0E-7(m/sec**2)

2.5.3 ACCEL9

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ACCEL999         7603901             1.80D-12
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCEL9 - Requests application and/or adjustment of general acceleration.	
9	I1	Indicates direction of 9 parameter general acceleration	0
		1 - Along Track ((R x V) x R) 2 - Cross Track (R x V) 3 - Radial (R)	
10	I1	Indicates type of 9 parameter general acceleration parameter	0
		1 - Cosine coefficient (A) 2 - Sine coefficient (B) 3 - Constant (C)	
11-12	I2	Indicates if this card will be used to specify period end time for 9 parameter general acceleration option. See NOTE[2] for details.	0
		99 - Card DOES specify 9 parameter general acceleration end time.	
13	I1	Thrust Index	
		0 - Acceleration 1 - Acceleration Thrust	
18-24	I7	Satellite ID (required).	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
25-44	D20.8	A priori value of acceleration coefficients.	0. M/S**2 or M/S**3 or M/S**4
45-59	D15.3	This field must be left blank unless the time dependent acceleration option is wanted. To select time dependent acceleration the end time of the period for which this acceleration coefficient applies is input in the form YYMMDDHHMMSS.SS in this field.	0.
60-72	D13.1	A priori sigma of acceleration	0. M/S**2

```
                          coefficient.                          or M/S**3
                                                                or M/S**4


NOTE[1]:
        When choosing the nine parameter general acceleration model,
        a card specifying the period endtime (99 in Cols.11-12) must
        precede all other cards.  A priori values for the coefficients
        in this period must follow subsequently.  One no longer has to
        include all nine cards for each coefficient in a period.



  EXAMPLE:   ACCEL cards for time dependent 9 parameter general accelerations



----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ACCEL9    99     7603901                       851230010000.00
ACCEL9  11      7603901             1.1D-11                            1.0D0
ACCEL9  12      7603901             2.2D-11                            1.0D0
ACCEL9  21      7603901             4.4D-11
ACCEL9  22      7603901             5.5D-11                            1.0D0
ACCEL9    99     7603901                       860101000000.00
ACCEL9  31      7603901             7.7D-11
ACCEL9  32      7603901             8.8D-11
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0



UNITS:  KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds



WARNINGS: If duplicate time periods are specified the run will terminate
          in IIS with a warning message.
          The first time period that exceeds the end time of the run
          (see EPOCH card) will be accepted. All other end times exceeding
          the end time of the run will be ignored.



IF CARD OMITTED: General accelerations are not applied
```

2.5.4 ACOEF

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ACOEF
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACOEF - Coefficients for Albedo or Emissivity Models.	
7-8	I2	Indicator of Albedo or Emissivity model 1 = Albedo 0 = Emissivity	
9-10	I2	Degree of coefficient	
11-12	I2	Order of coefficient	
25-44	D20.8	C - Coefficient value	0
45-59	D15.3	S - Coefficient value	0

The coefficients above should be unnormalized.

NOTE [1]: For a setup example see note on ALTIME card.

IF CARD OMITTED: And non-default Earth model has been requested,
                 run will abnormally terminate.

2.5.5   ALBEDO

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ALBEDO  2
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & UNITS

1-6      A6             ALBEDO - Requests application of earth
                        or other planet radiation pressure

7-8      I2             # of rings                            2

9-10     I2             Model indicator                       0

                        0 = default
                        1 = model provided below [Note 3]

11-12    I2             TUM model used if greater then zero    0
                        (only applicable to GPS satellites)
                        [Note 4]

25-44    D20.8          ALBEDO constant [Note 2]

45-59    D15.3          Emissivity constant [Note 2]
```

```
NOTE [1] : Solar radiation must be turned on when using ALBEDO.

NOTE [2] : If the albedo constant is zero, then the spherical
           harmonic albedo Earth model (currently zeroeth first
           and second degree zonal harmonics) will be used.
           If the emissivity constant is zero, then the spherical
           harmonic emissivity model (same as above) will be used.

NOTE [3] : For an example setup of this case look at the ALTIME card.

NOTE [4] : To use the TUM model, the following files must be
           present in the directory that IIE is executed:

              EMITM001
              EMITM002
              EMITM003
              EMITM004
              EMITM005
              EMITM006
              EMITM007
              EMITM008
              EMITM009
              EMITM010
              EMITM011
              EMITM012
              REFLM001
              REFLM002
              REFLM003
              REFLM004
              REFLM005
```

```
REFLM006
REFLM007
REFLM008
REFLM009
REFLM010
REFLM011
REFLM012
```

These files can be found in the following directory
on the xyz2 machine:

/Users/geodyn/SUPPORT/dat_FILES/dat_TUM/Earth_Radiation_Pressure

IF CARD OMITTED: Earth radiation pressure will not be applied.

2.5.6   ALTIME

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ALTIME
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS


1-6      A6         ALTIME - time input card for
                     albedo and emissivity


7-8      I2         Albedo or Emissivity indicator
                     1 = Albedo
                     0 = Emissivity


11-12    I2         Maximum degree of model following this card


13-14    I2         Maximum order of model following this card


21-22    I2         North latitude boundary for polar caps


23-24    I2         South latitude boundary for polar caps


25-44    D20.8      Begin solar longitude                    hours  in degrees of
                                                             arc  elapsed  since
                                                             local midnight


45-59    D15.3      End solar longitude                      hours  in degree of
                                                             arc  elapsed  since
                                                             local midnight


60-72    D13.1      Albedo or emissivity constant for north pole


73-80    D8.2       Albedo or emissivity constant for south pole

NOTE [1]:   GEODYN II input decks have been created with Albedo and
            emissivity coefficients for all solar longitude intervals
            in the following directories.


            /geod4/dmoore/alb
            alb.br010    alb.br084    alb.br130    alb.br205    alb.br290
            alb.br030    alb.br090    alb.br150    alb.br225    alb.br310
            alb.br050    alb.br110    alb.br168    alb.br250    alb.br330
            alb.br070    alb.br126    alb.br185    alb.br274    alb.br350


            /geod4/dmoore/emiss
            emiss.br010 emiss.br090 emiss.br168 emiss.br250 emiss.br350
            emiss.br030 emiss.br110 emiss.br170 emiss.br274
            emiss.br050 emiss.br126 emiss.br185 emiss.br290
            emiss.br070 emiss.br130 emiss.br205 emiss.br310
            emiss.br084 emiss.br150 emiss.br225 emiss.br330

NOTE [2]:   Example setup:

ALBEDO 6 1
ALTIME 0 0 3 3                           168.00              185.0
ACOEF   0 0 0              0.6762392000000D+00
ACOEF   0 1 0              0.9887231000000D-02
ACOEF   0 1 1             -0.7515130000000D+00-.916294200D-01
```

```
ACOEF   0 2 0              -0.5070995000000D+00
ACOEF   0 2 1              -0.9162940000000D-01  .297368800D-01
ACOEF   0 2 2               0.1177570000000D-00  .618260100D-02
ACOEF   0 3 0               0.6148761000000D-01
ACOEF   0 3 1               0.6778221000000D-01  .334011800D-02
ACOEF   0 3 2               0.2193671000000D-02 -.613645100D-02
ACOEF   0 3 3              -0.3966454000000D-02  .406565900D-03
ALTIME  1 0 6 0                          168.00              185.0
ACOEF   1 1 0               0.2396375000000D-03
ACOEF   1 2 0              -0.9454928600000D-01
ACOEF   1 3 0               0.7089286600000D-01
ACOEF   1 4 0              -0.8032406400000D-01
ACOEF   1 5 0               0.4525305700000D-01
ACOEF   1 6 0               0.3543102200000D-01


IF CARD OMITTED: And non-default Earth model has been requested,
                 run will abnormally terminate
```

2.5.7 ALTWVL

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+---8
ALTWVL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTWVL Provides the wavelenth of the altimeter laser. If altimetry data are being processed and this option is invoked, the value of the wavelength will override that provided on the data records.	microns
18-24	I7	Satelltite ID.	
25-44	D20.8	Wavelength in microns.	

IF CARD OMITTED: The wavelength provided by the data will be used.

2.5.8 ATITUD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ATITUD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests application and/or adjustment of attitude angles (roll, pitch, yaw).	
7	I1	Index defining the attitude angle 1 - Roll 2 - Pitch 3 - Yaw	
8	I1	Index defining the term of the polynomial. 0 - constant term 1 - Coefficient of linear term 2 - Coefficient of quadratic term 3 - Coefficient of amplitude 4 - Coefficient of phase	
10-11	I3	Indicates if this card will be used to specify end time for application. 99 - Card DOES specify application end time. 00 - Card provides a-priori values and sigmas for parameters.	
12-14	I3	If cols 10-11 are 99 then this 3 digit integer represents the sequence of rotations for this period of time for the S/C ex: 123 means first apply roll, then pitch, last yaw. 312 means first apply yaw, then roll, last pitch. If cols 10-11 are 00 this field must be filled with the laser number. For the S/C this number should be 00 (See example). =999 This attitude parameter is a force model parameter. It works only in combination with the DYNSEL option.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	If cols 10-11 are 99 then this 3 digit number represents the sequence of rotations for the individual lasers and for this period of time All the individual lasers will have the same sequence of rotation. Also in this case a	

```
                      combination of the numbers 1,2,3
                      should be used.

18-24   I7            Satellite ID.

25-44   D20.8         If cols 10-11 are 00 this field
                      contains the a-priori value of
                      the coefficient.
                      If cols 10-11 are 99 this field
                      must be empty.

45-59   D15.3         If cols 10-11 are 99 this field
                      contains the end time of application
                      of the parameters that follow.

                      If cols 10-11 are 00 this field
                      must be empty.  The period that
                      ends at the specified time, begins
                      at the previous end time or at
                      EPOCH time.  The end time is in
                      the form:  YYMMDDHHMMSS.SS.

60-72                 If cols 10-11 are 00 this field
                      contains the standard deviation
                      of the coefficient. If this field
                      is zero, GEODYN will assign a
                      very small standard deviation to
                                          -30
                      the parameter 1x10    .
                      If cols 10-11 are 00 this field
                      contains the period of the S/C
```

The example below requests adjustment of roll, pitch and yaw (complete
five term polynomial: constant, linear, quadratic, amplitude and phase
terms) with a sigma 1.D0 for each parameter. The S/C (id=9252010) has a
laser instrument (id=001) and a solution is requested for both S/C and
laser instrument at time periods:
1. EPOCH   - 930219031600.00
2. 930219031600.00 - 930219111600.00
The sequence of rotations for the S/C is: ROLL-PITCH-YAW
The sequence of rotations for the laser is: ROLL-PITCH-YAW

```
ATITUDE  991231239205201                       930219031600.00
ATITUD10   000    9205201  +.0100000000000D-02                 .100000D+01
ATITUD11   000    9205201  +.0200000000000D-05                 .100000D+01
ATITUD12   000    9205201  +.0300000000000D-11                 .100000D+01
ATITUD13   000    9205201  +.0400000000000D-11                 .100000D+01
ATITUD14   000    9205201  +.0500000000000D-11                 .100000D+01
ATITUD20   000    9205201  +.0400000000000D-02                 .100000D+01
ATITUD21   000    9205201  +.0500000000000D-05                 .100000D+01
ATITUD22   000    9205201  +.0600000000000D-11                 .100000D+01
ATITUD23   000    9205201  +.0700000000000D-11                 .100000D+01
ATITUD24   000    9205201  +.0800000000000D-11                 .100000D+01
ATITUD30   000    9205201  +.0700000000000D-02                 .100000D+01
ATITUD31   000    9205201  +.0800000000000D-05                 .100000D+01
ATITUD32   000    9205201  +.0900000000000D-11                 .100000D+01
ATITUD33   000    9205201  +.1000000000000D-11                 .100000D+01
```

```
ATITUD34    000    9205201 +.1100000000000D-11                    .100000D+01
ATITUD10    001    9205201 +.1100000000000D-02                    .100000D+01
ATITUD11    001    9205201 +.1200000000000D-05                    .100000D+01
ATITUD12    001    9205201 +.1300000000000D-11                    .100000D+01
ATITUD13    001    9205201 +.1400000000000D-11                    .100000D+01
ATITUD14    001    9205201 +.1500000000000D-11                    .100000D+01
ATITUD20    001    9205201 +.1400000000000D-02                    .100000D+01
ATITUD21    001    9205201 +.1500000000000D-05                    .100000D+01
ATITUD22    001    9205201 +.1600000000000D-11                    .100000D+01
ATITUD23    001    9205201 +.1700000000000D-11                    .100000D+01
ATITUD24    001    9205201 +.1800000000000D-11                    .100000D+01
ATITUD30    001    9205201 +.1700000000000D-02                    .100000D+01
ATITUD31    001    9205201 +.1800000000000D-05                    .100000D+01
ATITUD32    001    9205201 +.1900000000000D-11                    .100000D+01
ATITUD33    001    9205201 +.2000000000000D-11                    .100000D+01
ATITUD34    001    9205201 +.2100000000000D-11                    .100000D+01
ATITUD   991233219205201                        930219111600.00
ATITUD10    000    9205201 +.0100000000000D-02                    .100000D+01
ATITUD11    000    9205201 +.0200000000000D-05                    .100000D+01
ATITUD12    000    9205201 +.0300000000000D-11                    .100000D+01
ATITUD13    000    9205201 +.0400000000000D-11                    .100000D+01
ATITUD14    000    9205201 +.0500000000000D-11                    .100000D+01
ATITUD20    000    9205201 +.0100000000000D-02                    .100000D+01
ATITUD21    000    9205201 +.0200000000000D-05                    .100000D+01
ATITUD22    000    9205201 +.0300000000000D-11                    .100000D+01
ATITUD23    000    9205201 +.0400000000000D-11                    .100000D+01
ATITUD24    000    9205201 +.0500000000000D-11                    .100000D+01
ATITUD30    000    9205201 +.0100000000000D-02                    .100000D+01
ATITUD31    000    9205201 +.0200000000000D-05                    .100000D+01
ATITUD32    000    9205201 +.0300000000000D-11                    .100000D+01
ATITUD32    000    9205201 +.0400000000000D-11                    .100000D+01
ATITUD42    000    9205201 +.0500000000000D-11                    .100000D+01
ATITUD10    001    9205201 +.0100000000000D-02                    .100000D+01
ATITUD11    001    9205201 +.0200000000000D-05                    .100000D+01
ATITUD12    001    9205201 +.0300000000000D-11                    .100000D+01
ATITUD13    001    9205201 +.0400000000000D-11                    .100000D+01
ATITUD14    001    9205201 +.0500000000000D-11                    .100000D+01
ATITUD20    001    9205201 +.0100000000000D-02                    .100000D+01
ATITUD21    001    9205201 +.0200000000000D-05                    .100000D+01
ATITUD22    001    9205201 +.0300000000000D-07                    .100000D+01
ATITUD23    001    9205201 +.0400000000000D-07                    .100000D+01
ATITUD24    001    9205201 +.0500000000000D-07                    .100000D+01
ATITUD30    001    9205201 +.0100000000000D-11                    .100000D+01
ATITUD31    001    9205201 +.0200000000000D-05                    .100000D+01
ATITUD32    001    9205201 +.0300000000000D-07                    .100000D+01
ATITUD33    001    9205201 +.0400000000000D-07                    .100000D+01
ATITUD34    001    9205201 +.0500000000000D-07                    .100000D+01
```

In the same example as above, if one wishes to solve only for Yaw constant
and linear terms and for the same periods of time the input reduces to :

```
ATITUDE  991231239205201                        930219031600.00
ATITUD30    000    9205201 +.0700000000000D-02                    .100000D+01
ATITUD31    000    9205201 +.0800000000000D-05                    .100000D+01
ATITUD30    001    9205201 +.1700000000000D-02                    .100000D+01
ATITUD31    001    9205201 +.1800000000000D-05                    .100000D+01
ATITUD   991233219205201                        930219111600.00
ATITUD30    000    9205201 +.0100000000000D-02                    .100000D+01
```

```
ATITUD31    000    9205201 +.0200000000000D-05                        .100000D+01
ATITUD30    001    9205201 +.0100000000000D-11                        .100000D+01
ATITUD31    001    9205201 +.0200000000000D-05                        .100000D+01
```

In the above case GEODYN will assign zero values and sigmas =1.D-30 to all
the other parameters in the model. In general, if only one parameter in the
model has been assigned a sigma, GEODYN will use a full model parameterization
scheme with tight sigmas for all the other parameters.

Here is an example of Attitude parameters that will be considered
as force model parameters. This capability is possible only along
with the DYNSEL accelerometer option.

```
ATITUD    999999992000039                      000808000000.00
ATITUD10    000    2000039 0.1010000                              1.0
ATITUD11    000    2000039 0.0000000                              1.0
ATITUD12    000    2000039 0.0000000
ATITUD13    000    2000039 0.0000000
ATITUD14    000    2000039 0.0000000
ATITUD20    000    2000039 0.0150000                              1.0
ATITUD21    000    2000039 0.0000000                              1.0
ATITUD22    000    2000039 0.0000000
ATITUD23    000    2000039 0.0000000
ATITUD24    000    2000039 0.0000000
ATITUD30    000    2000039 0.0000000
ATITUD31    000    2000039 0.0000000
ATITUD32    000    2000039 0.0000000
ATITUD33    000    2000039 0.0000000
ATITUD34    000    2k00039 0.0000000
```

IF CARD OMITTED: Attitude modeling will not be invoked in GEODYN

2.5.9 CAMERA

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
CAMERA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT        DESCRIPTION                        DEFAULT VALUE & UNITS

1-6      A6           CAMERA - Requests application and/or
                      adjustment of camera distortion parameters

7        I1           Parameter Index (1-8)

                          1-5 : Focal length/Distortion parameter
                                (Adjustable)
                            6 : Center Pixel Coordinates
                                (Unadjustable)
                          7-8 : K-Matrix parameter
                                (Unadjustable)

18-24    I7           Camera ID number

                      FOR PARAMETER INDICES 1-5
25-44                 Parameter value (a-priori)
45-59                 Parameter sigma

                      FOR PARAMETER INDEX 6
25-44                 First Center Pixel Coordinate
45-59                 Second Center Pixel Coordinate

                      FOR PARAMETER INDEX 7
25-44                 K-MATRIX(1)
45-59                 K-MATRIX(2)
60-72                 K-MATRIX(3)

                      FOR PARAMETER INDEX 8
25-44                 K-MATRIX(4)
45-59                 K-MATRIX(5)
60-72                 K-MATRIX(6)
```

EXAMPLE: CAMERA cards to define all camera parameters:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CAMERA1         2007043            150.07328      0.0004D-03
CAMERA2         2007043         0000000D-06     0.04308D-03
CAMERA3         2007043         0000000D-06     0.04308D-03
CAMERA4         2007043         0000000D-06     0.04308D-03
CAMERA5         2007043         0000000D-06     0.04308D-03
CAMERA6         2007043            512.5D0           512.5D0
CAMERA7         2007043          71.4286D0       0.00000D0        0.0D0
CAMERA8         2007043          0.00386D0      -71.44341D0       0.0D0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

2.5.10 CON9PA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CON9PA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Introducing constraints for time dependent 9 parameter general acceleration	
7	I1	Direction of 9 parameter general acceleration 1 = along track 2 = cross track 3 = radial	
8	I1	Type of 9 parameter general acceleration. 1 = cosine coefficient 2 = sine coefficient 3 = constant	
9	I1	[2] Indicator used to indicate if the normal matrix will be updated in the last inner iteration according to constraints: 0 - IIE will NOT update the normal matrix before writing EMATRIX file. 1 - IIE will update the normal matrix before writing EMATRIX file.	'0'
18-24	I7	Satellite ID.	
25-44	D20.3	Begin time of adjacent [1] periods to be constrained.	YYMMDDHHMMSS.SS
45-59	D15.3	End time of adjacent periods to be constrained.	YYMMDDHHMMSS.SS
60-72	D13.1	Weight assigned to adjacent periods	
73-80	D8.3	Correlation time.	sec

NOTE [1]: Only one CON9PA card is needed to constrain a number of adjacent
          periods from ACCEL9. If some periods from the ACCEL9 stream are
          excluded from constrained adjustments, use as many CON9PA cards as
          the number of sets of continuous adjacent periods.

NOTE [2]: If a value other than 0 or 1 is present in column 9 GEODYN IIS will
          stop and show an error message.

2.5.11 CONBIA

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+----8
CONBIA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                       DEFAULT VALUE & UNITS

1-6     A6         Introducing constraints for
                   time dependent tropospheric biases.

 7-14    I8         Station ID

15-17    I3         Type of bias to be constrained

                    =500 for tropospheric biases

25-44   D20.3      Begin time of adjacent [2] periods       YYMMDDHHMMSS.SS
                   to be constrained.

45-59   D15.3      End time of adjacent periods to be       YYMMDDHHMMSS.SS
                   constrained.

60-72   D13.1      Weight assigned to adjacent periods.

73-80   D8.3       Correlation time.                        sec

NOTE [1]: The CONBIA option is station dependent, therefore the station ID
          is required.

NOTE [2]: Only one CONBIA card is needed to constrain a number of adjacent
          periods from MBIAS.  If some periods from the MBIAS stream are
          excluded from constrained adjustments, use as many CONBIA cards
          as the number of sets of continuous adjacent periods.
```

2.5.12 CONDRG

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONDRG
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                    DEFAULT VALUE & UNITS

1-6     A6            Introducing constraints for
                      time dependent drag.

9       I1            [2] Indicator used to indicate if the
                      normal matrix will be updated in the
                      last inner iteration according to
                      constraints:

                       0 - IIE will NOT update the normal         '0'
                           matrix before writing EMATRIX
                           file.
                       1 - IIE will update the normal
                           matrix before writing EMATRIX
                           file.

18-24    I7           Satellite ID.

25-44   D20.3         Begin time of adjacent [1] periods   YYMMDDHHMMSS.SS
                      to be constrained.

45-59   D15.3         End time of adjacent periods to be   YYMMDDHHMMSS.SS
                      constrained.

60-72   D13.1         Weight assigned to adjacent periods.

73-80   D8.3          Correlation time.                    sec
```

NOTE [1]: Only one CONDRG card is needed to constrain a number of adjacent
          periods for time dependent DRAG. If some periods from the
          DRAG stream are excluded from constrained adjustments, use as many
          CONDRG cards as the number of sets of continuous adjacent periods.

NOTE [2]: If a value other than 0 or 1 is present in column 9 GEODYN IIS will
          stop and show an error message.

2.5.13 CONSOL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONSOL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6            Introducing constraints for
                      time dependent solar radiation.

18-24    I7           Satellite ID.

25-44   D20.3         Begin time of adjacent [1] periods        YYMMDDHHMMSS.SS
                      to be constrained.

45-59   D15.3         End time of adjacent periods to be        YYMMDDHHMMSS.SS
                      constrained.

60-72   D13.1         Weight assigned to adjacent periods.

73-80   D8.3          Correlation time.                         sec


NOTE [1]: Only one CONSOL card is needed to constrain a number of adjacent
          periods for time dependent SOLRAD.  If some periods from the
          SOLRAD stream are excluded from constrained adjustments, use as many
          CONSOL cards as the number of sets of continuous adjacent periods.
```

2.5.14 CONSPL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONSPL  20001304        0.1                 0.1             0.1           0.1
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                       DEFAULT VALUE  UNITS

1-6     A6              CONSPL  - Input information for VLBI spline
                        parameters constraints.

7-14    I8              Station Number.                        0

15-17   I3              Bias Type. See list of bias types after     0
                        this option description.

25-44   D20.8           Standard deviation for degree 0

45-59   D15.3           Standard deviation for degree 1

60-72   D13.1           Standard deviation for degree 2

73-80   D8.2            Standard deviation for degree 3


UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds


IF CARD OMITTED:  No constraints will be applied to the spline type biases.
```

2.5.15 DSTATE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DSTATE
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DSTATE - Requests estimation of an instantaneous state difference at a specific time. This capability is extremely useful with thrusts	
7	I1	Dstate Component 1 = x 2 = y 3 = z . 4 = x . 5 = y . 6 = z	
8	I1	Coordinate system of input indicator =1 Inertial TOR coordinate system =2 Position and velocity are in the satellite along track, cross track and radial directions.	
18-24	I7	Satellite ID.	0
25-44	D20.8	Dstate value	0.0
45-59	D15.3	Dstate time (YYMMDDHHMMSS.SS)	
60-72	D13.1	Dstate sigma	1.D-25

NOTE 1:   The DSTATE option requires that all the data from one satellite
          should be input together and in advanced time order. Also all
          the satellites must be in the same order as on the SATPAR input
          cards.
          Not all 6 components of the DSTATE at a specific time must be
          present if the user does not wish to solve for them, however
          GEODYN will use a tight sigma for those components that are
          not present in the estimation process

NOTE 2:   The DSTATE option is a force model option, but no forces
          are associated with the DSTATE parameters. The DSTATE parameters
          simply cause the COWELL numerical integration sums to be
          altered. There are two integration scenarios: INTGCB option
          and no INTGCB option (see INTGCB card). The user needs to be

aware of these two scenarios when using DSTATE parameters.

NOTE 2a: When no INTGCB card is present only the orbit of the artificial
            satellite (and not the orbited body) is being numerically
            integrated. In this mode, the DSTATE option requires the use of
            multi-rate integration. Multi-rate integration is accessed
            by using in columns 60-72 of the STEP card. Note that unlike
            most applications that require multi-rate integration, the
            DSTATE option does NOT require the use of the HRATEF card.

NOTE 2b: When an INTGCB card is present, both the orbit of the artificial
            satellite well as the orbited body are being numerically
            integrated. In this mode, multi-rate integration is not
            possible and prior to version 1507.11 DSTATE modeling was
            not available together with INTGCB. Starting with version
            1507.11 DSTATE modeling without multi-rate integration is
            possible when using the INTGCB capability. In this mode,
            the DSTATE option requires that a 1 second step size is
            used. If a DSTATE epoch occurs in-between integration steps,
            the DSTATE event will be modeled at the nearest integration step.

2.5.16 DRAG

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DRAG   0         7654321 2.3
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS	
1-6	A6	DRAG - Modifies drag application and/or requests estimation of drag coefficients.		

8	I1	Indicates order of drag coefficients:
		
		   0 - Cd
		      .
		   1 - Cd
		      ..
		   2 - Cd
			0	

18-24	I7	Satellite ID (required).	0	
25-44	D20.8	Drag coefficient.(For $\dot{Cd}$ and $\ddot{Cd}$ the units are per second and per second squared)	0.	none or 1/S or 1/S**2
45-59	D15.3	This field must be left blank unless the time dependent drag option is wanted. To select time dependent drag specify the end time of the period for which this acceleration coefficient applies in the form YYMMDDHHMMSS.SS in this field. See NOTE[1] for more details.	0.	
60-72	D13.1	Standard deviation of drag coefficient.		none or 1/S or 1/S**2

NOTE[1]:
> Time periods may be specified only for the highest order coefficients used (i.e. if Cd and Cd dot are used, only Cd dot can have time intervals).
>
> When using time periods the number of drag cards required is equal to the number of time periods plus the order (order = the number in column 8 +1).
>
> The first DRAG card with an end time covers the time period from epoch to the specified end time. Subsequent drag cards with end times cover the time interval from the preceeding end time to the current end time. In this manner continuous time intervals are guaranteed from epoch to the last specified end time. If orbit integration continues beyond the end of the last specified drag time interval, the Cd (or Cd dot, or Cd double dot) without a time interval is used. A Cd (or Cd dot or Cd double dot) without a time interval is MANDATORY when using this time dependent option. See example below.

```
  EXAMPLE:  Drag cards for using time dependent drag coefficients.
            (highest order - Cd dot;two time intervals;  4 cards required)


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DRAG    0         7654321 2.3
DRAG    1         7654321 .00002
DRAG    1         7654321 .000021                  840902000000.
DRAG    1         7654321 .000022                  840903000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0



WARNINGS: If duplicate time periods are specified the run will terminate
          in IIS with a warning message.
          The first time period that exceeds the end time of the run
          (see EPOCH card) will be accepted. All other end times exceeding
          the end time of the run will be ignored.

UNITS:  KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds


IF CARD OMITTED: Drag is applied with a default Cd of 2.3
```

2.5.17 EBIAS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EBIAS          51          1.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EBIAS - Requests adjustment of pass by pass measurement biases.	
7-14	I8	Station Number. [2]	0
15-17	I3	Bias Type. See list of bias types after this option description. [2]	0
18-24	I7	Satellite ID. [2]	0
45-59	D15.3	Start date and time for generating pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.
60-72	D13.1	End date and time for generation of pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.

NOTE [1]: If the start and end dates are left blank electronic biases
          will be generated for the entire data span.

NOTE [2]: The station number, satellite ID and bias type are required.
          Blanks and /or zeroes will not work.

NOTE [3]: If the measurement type is larger than 99 (3 digit) use
          EBIASM card to specify it.

GEODYN-II E-BIAS TYPES

The GEODYN-II E-bias types include all of the GEODYN-II measurement types as well as other types which are an extension of the simple measurement bias.

At present, the only E-bias types defined include simple constant measurement biases. Other future E-bias types will include linearly varying measurement biases and observation scale biases.

E-bias type numbers are assigned as follows:

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	STATION DEPENDENT
simple measurement biases	measurement type	no or	yes
measurement bias varying linearly with time	meas. type + 100	no or	yes
measurement scale bias	meas. type + 200	no or	yes

```
tropospheric refraction                          500         no    or    yes
scale bias
```

2.5.18   EBIASM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
EBIASM        100
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EBIASM - This card is used when the measurement type is larger than 99 (3 digit). The 3 digits in columns 15-17 will overwrite the measurement type in columns 16-17 of the PBIAS card. Requests adjustment of pass by pass measurement biases.	
15-17	I3	Measurement Type.	0

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the
                   EBIAS card.

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2.5.19 EDIT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EDIT                    3.5                 200.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EDIT - Specifies editing multiplier and initial RMS value.	
7	I1	Special editing switch. = 0 Normal editing performed. = 1 Perform local pass editing on 1st iteration. = 2 Perform local pass editing on all iterations.	0
25-44	D20.8	Editing multiplier. This number remains constant for all iterations in the arc.	3.5
45-59	D15.3	Editing RMS. Initial RMS value used for iteration number 1. Subsequent iterations use the RMS from the previous iteration.	200.
60-72	D13.1	Electronic bias edit level.	Value in cols. 25-44 times value in cols. 45-59.
73-80	D8.2	Arc convergence criteria.	.02

NOTES:
[1] The editing level for each iteration is determined as follows:

Edit level = Edit multiplier * Edit RMS

[2] The "ratio to sigma" for each observation is compared to this edit
level and "ratio to sigmas" greater than the edit level are
eliminated from the current iterations solution.

[3] The electronic bias edit level defaults to the same edit level as
described above. (edit multiplier * edit RMS)

NOTES: (continued)

[4] Time periods may be specified only for the highest order
coefficients

[5] Convergence on first iteration
GEODYN II will converge on the first inner iteration if the
RMS on the EDIT card is within 2% of the first iteration RMS

[6] E-bias Edit level
For E-bias editing the E-bias edit level is given by default

as the edit multiplier * RMS from the EDIT card. If the
"electronic bias edit level" from columns 60-72 of the EDIT
card is non zero, then the value from column 60-72 is used as
the edit level (Not the value in column 60-72 times anything else)

IF CARD OMITTED: The default edit level of 700 (3.5*200) is used.

2.5.20 EMATRX

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EMATRX  1              123456.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

1-6	A6	EMATRX - Requests output of an E-matrix file on unit 71 and on option a V-matrix file on unit 80. Also automatically requests partitioned formation of normal equations.	
8	I1	> 0 indicates a V-matrix file will also be output.	0
9	I1	E-matrix print options 0 - E-matrix is not printed. 1 - E-matrix header and label information is printed. 2 - Complete E-matrix is printed.	0
15-17	I3	Number of processors to be used for an EMAT run	
25-44	D20.8	E-matrix number. This number may be any number greater than 0.	0.
45-59	D15.3	Stop date for V-matrix output in form YYMMDDHHMMSS.	0.
60-72	D13.1	Output interval in seconds for the V-matrix. If a V-matrix has been requested this number must be greater than zero in order to get a V-matrix at regular times. If the V-matrix is requested at measurement times, this number should be greater than negative one and less than or equal to zero. V-matrix partials will be output in the true of reference coordinate system.	0. S
73-80	D8.2	Sigma used in the case of a Reduced Normal Matrix case. (NOTE 1)	

NOTE 1: GEODYN considers the adjusted parameters as a group of parameters
     where all adjust with their assigned sigma value.
     Some parameters are often tightly constrained and do not change with
     the adjustments. This scenario may produce very large normal matrices.
     With this option any GEODYN parameter for which the sigma is less than a
     certain constant, will not be contributing in the normal matrix.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No E-matrix of V-matrix will be output.

SEE ALSO: VECOPT option in Global Set.

NOTE: [1] The input elements for the S/C in an interplanetary run
          must refer to the IAU system otherwise V-matrix values
          will be erroneous. See ELEMS1 and ELEMS2 cards.

2.5.21 FANTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FANTIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTIM - Used for time dependent PHANTOM parameters (option FANTOM)	
7	I1	Index specifying the nature of the introduced arc parameters: = 1 Geometric model arc parameters = 2 Force model arc parameters	
25-44	D20.8	Epoch time for a time dependent model [NOTE 1]	YYMMDDHHMMSS.
45-59	D15.3	Start time for a time dependent option. The end times are specified on the FANTOM cards.	YYMMDDHHMMSS.
60-72	D13.1	Space for real information applicable to all the parameters in the group.	
73-80	D8.2	Space for real information applicable to all the parameters in the group	

   NOTES:

      [1] This time will be considered to be a reference time with respect to
          which linear rates or periodic terms are evaluated.

      [2] Only one FANTIM card per FANTOM parameter group is allowed.

IF CARD OMITTED: And times are included on the FANTOM cards, the run will
abnormally terminate.

CG OFFEST PARAMETERS USING FANTIM:

This option uses FANTOM cards to model the center of gravity offset in
the x, y and z components in the satellite body-fixed frame.

FANTIM

----

col.   7   1 - means arc geometric FANTOM parameters

col. 25-44   Epoch time for a time dependent model   YYMMDDHHMMSS.
                [NOTE 1]

col. 45-59   Start time for a time dependent option. The   YYMMDDHHMMSS.
                end times are specified on the FANTOM cards.

See ARC FANTOM OPTION FOR THE FANTOM SPECIFICATIONS

2.5.22   FANTOM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FANTOM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTOM - Introduces the application and/or estimation of a group of arc parameters [NOTE 3]	
7	I1	Index specifying the nature of the introduced arc parameters:	

        = 1 Geometric model arc parameters
        = 2 Force model arc parameters

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
8	I1	Index specifying a specific direction for the parameter appearing on cols 25-44 [NOTE 1]	

        = 0 All the parameters in the group are
          treated the same way (same partial formulation)

        = 1 |
        = 2 | To be specified by the user
        = 3 |

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9	I1	Index specifying the nature of the contents on cols 60-72 and 73-80	

        = 0 These real fields are not used for
        the group of parametrs introduced. (Space
        will not be allocated for them in GEODYN).
        = 1 These real fields are used as they
        are described below
        = 2 These real fields may be used to include
        any type of real information (but time)

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	I7	Satellite ID	
25-44	D20.8	Parameter value	
45-59	D15.3	Parameter sigma	
60-72	D13.1	End time for application for this parameter. YYMMDDHHMMSS. (if the index on col 9 is 2) [NOTE 2]	
73-80	D8.2	Available space for extra real information.	

  NOTES:

     [1] Specify up to three (3) dimensions. Although this option is not
         required in order to solve for parameters in a 3-D space or solve

for parameters of different significance (S and S coefficients for example) it is helpful for EMATS and other types of labeling. Also parameters with the same index will be grouped together, facilitating that way the formation of partials.

[2] Requires the presence of the FANTIM option.

[3] This option provides the necessary allocation and links for parameterizaton. In order to use this option, the user must contact a GEODYN programmer for further additions of modeling and partials code.

IF CARD OMITTED: No extra model or parameters will be included in the GEODYN calculations

CG OFFEST PARAMETERS USING FANTIM:

This option uses FANTOM cards to model the center of gravity offset in the x, y and z components in the satellite body-fixed frame.

FANTOM

----

col.   7   1 - means arc geometric FANTOM parameters

col.   8   component number (x = 1, y = 2, z = 3)

col.   9   must be = 2 to specify col. 60-72 contains the sinusoidal period

col. 18-24   Satellite ID

col. 25-44   Parameter value

col. 45-59   Parameter sigma [NOTE 2]

col. 60-72   Period for the sinusoidal function in sec.

NOTES:

[1] This time will be considered to be a reference time with respect to

    which linear rates or periodic terms are evaluated.

[2] The parameter sigma must always be non-zero for this model. If a FANTOM paramete

    to be adjusted, set the sigma to a very small positive number.

It is assumed that you will have 15 FANTOM cards, one for each of the parameters in the

The cgmass offset is modeled in the satellite body fixed frame as:

x_offset = a(1) + a(2) * sin(twopi * t / period(2)) + a(3) * cos(twopi * t / period

                 a(4) * sin(twopi * t / period(4)) + a(5) * cos(twopi * t / period

y_offset = a(6) + a(7) * sin(twopi * t / period(7)) + a(8) * cos(twopi * t / period

                 a(9) * sin(twopi * t / period(9)) + a(10) * cos(twopi * t / period

z_offset = a(11)+ a(12) * sin(twopi * t / period(12)) + a(13) * cos(twopi * t / period

                 a(14) * sin(twopi * t / period(14)) + a(15) * cos(twopi * t / period

where:

        a(i) is the value on the ith FANTOM card

    period(i) is the period on the ith FANTOM card

The periods on cards 1, 6 and 11 are not used.

An example set of FANTOM cards is:

```
FANTIM1                    90802140000.        90802140000.

FANTOM112        8032001  0.00              1.00        E-02    0.
FANTOM112        8032001  0.00              1.00        E-02 3600.
FANTOM112        8032001  0.00              1.00        E-02 3600.
FANTOM112        8032001  0.00              1.00        E-02 7200.
FANTOM112        8032001  0.00              1.00        E-02 7200.
FANTOM122        8032001  0.00              1.00        E-02    0.
FANTOM122        8032001  0.00              1.00        E-02 3600.
FANTOM122        8032001  0.00              1.00        E-02 3600.
FANTOM122        8032001  0.00              1.00        E-02 7200.
FANTOM122        8032001  0.00              1.00        E-02 7200.
FANTOM132        8032001  0.00              1.00        E+02    0.
FANTOM132        8032001  0.00              1.00        E-02 3600.
FANTOM132        8032001  0.00              1.00        E-02 3600.
FANTOM132        8032001  0.00              1.00        E-02 7200.
FANTOM132        8032001  0.00              1.00        E-02 7200.
```

2.5.23 FNBURN SUBGROUP

2.5.23.1 FNBURN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FNBURN            9601101   200402082905.0000     .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                          DEFAULT VALUE & UNITS

1-6      A6          FNBURN - Introduces the application and/or
                     estimation of finite burn parameters
             FNBURN is the first card in a group of cards
                     which also contains the cards THRUST,FLRATE,THRRTA,
                     THRDEC, and end ends with the card ENDBRN.
                     Each of the cards above is described separately.
                     An example of the FNBURN group is given below (NOTE 1)

18-24    I7          Satellite ID

25-44    D20.8       Date in YYMMDDHHMMSS.SSSS UT

45-59    D15.3       Parameter sigma

[NOTE 1]:
FNBURN            1606401   181015170000.3990    1.000000D-50
THRUST1                     1.0922824000D+02     5.282000D-50
THRUST2                     4.1985467000D+00     1.000000D-50
THRUST3                    -3.9539867000D-01     1.000000D-50
THRUST4                     1.5605763000D-02     1.000000D-50
THRUST5                    -2.1846148000D-04     1.000000D-50
FLRATE0                     1.4917600000D+03     1.000000D-50
FLRATE1                     5.3764724000D-02     2.301200D-55
FLRATE2                     0.0000000000D+00     1.000000D-50
FLRATE3                     0.0000000000D+00     1.000000D-50
FLRATE4                     0.0000000000D+00     1.000000D-50
THRRTA1                     8.3447575000D+01     4.332500D-55
THRRTA2                     0.0000000000D+00     1.000000D-50
THRRTA3                     0.0000000000D+00     1.000000D-50
THRRTA4                     0.0000000000D+00     1.000000D-50
THRRTA5                     0.0000000000D+00     1.000000D-50
THRDEC1                     7.5908608000D+00     4.332500D-55
THRDEC2                     0.0000000000D+00     1.000000D-50
THRDEC3                     0.0000000000D+00     1.000000D-50
THRDEC4                     0.0000000000D+00     1.000000D-50
THRDEC5                     0.0000000000D+00     1.000000D-50
ENDBRN1                     3.0000000000D+01     1.284000D-55
ENDBRN                                           1.000000E-50
ENDBRN                                           1.000000E-50
ENDBRN                                           1.000000E-50
FNBEND
FNBURN            1606401   181015170030.3990    1.000000D-50
THRUST1                     8.6930216000D+02     4.114100D+01
THRUST2                     0.0000000000D+00     1.000000D+01
THRUST3                     0.0000000000D+00     1.000000D+01
THRUST4                     0.0000000000D+00     1.000000D+01
THRUST5                     0.0000000000D+00     1.000000D+01
FLRATE0                     1.4901440000D+03     1.000000D-50
FLRATE1                     3.6994717000D-01     1.792400D-55
FLRATE2                     0.0000000000D+00     1.000000D-50
```

```
FLRATE3                         0.0000000000D+00    1.000000D-50
FLRATE4                         0.0000000000D+00    1.000000D-50
THRRTA1                         8.3501789000D+01    2.731100D-55
THRRTA2                         0.0000000000D+00    1.000000D-50
THRRTA3                         0.0000000000D+00    1.000000D-50
THRRTA4                         0.0000000000D+00    1.000000D-50
THRRTA5                         0.0000000000D+00    1.000000D-50
THRDEC1                         7.7018506000D+00    2.731100D-55
THRDEC2                         0.0000000000D+00    1.000000D-50
THRDEC3                         0.0000000000D+00    1.000000D-50
THRDEC4                         0.0000000000D+00    1.000000D-50
THRDEC5                         0.0000000000D+00    1.000000D-50
ENDBRN1                         2.2436700000D+02    7.479700D-01
ENDBRN                                              1.000000E-50
ENDBRN                                              1.000000E-50
ENDBRN                                              1.000000E-50
FNBEND
```

IF CARD OMITTED: The finite burn model will not be considered in this run.
calculations

2.5.23.2 THRUST

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRUST1                                  0.5          .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRUST - Defines the thrust coefficients`	
7	I1	Order of coefficient	
25-44	D20.8	A-priori value (newtons/sec**order)	
45-59	D15.3	Parameter sigma	

Sample FNBURN group setup featuring THRUST

```
FNBURN          1606401   181015170000.3990   1.000000D-50
THRUST1                     1.0922824000D+02   5.282000D-50
THRUST2                     4.1985467000D+00   1.000000D-50
THRUST3                    -3.9539867000D-01   1.000000D-50
THRUST4                     1.5605763000D-02   1.000000D-50
THRUST5                    -2.1846148000D-04   1.000000D-50
FLRATE0                     1.4917600000D+03   1.000000D-50
FLRATE1                     5.3764724000D-02   2.301200D-55
FLRATE2                     0.0000000000D+00   1.000000D-50
FLRATE3                     0.0000000000D+00   1.000000D-50
FLRATE4                     0.0000000000D+00   1.000000D-50
THRRTA1                     8.3447575000D+01   4.332500D-55
THRRTA2                     0.0000000000D+00   1.000000D-50
THRRTA3                     0.0000000000D+00   1.000000D-50
THRRTA4                     0.0000000000D+00   1.000000D-50
THRRTA5                     0.0000000000D+00   1.000000D-50
THRDEC1                     7.5908608000D+00   4.332500D-55
THRDEC2                     0.0000000000D+00   1.000000D-50
THRDEC3                     0.0000000000D+00   1.000000D-50
THRDEC4                     0.0000000000D+00   1.000000D-50
THRDEC5                     0.0000000000D+00   1.000000D-50
ENDBRN1                     3.0000000000D+01   1.284000D-55
ENDBRN                                         1.000000E-50
ENDBRN                                         1.000000E-50
ENDBRN                                         1.000000E-50
FNBEND
FNBURN          1606401   181015170030.3990   1.000000D-50
THRUST1                     8.6930216000D+02   4.114100D+01
THRUST2                     0.0000000000D+00   1.000000D+01
THRUST3                     0.0000000000D+00   1.000000D+01
THRUST4                     0.0000000000D+00   1.000000D+01
THRUST5                     0.0000000000D+00   1.000000D+01
FLRATE0                     1.4901440000D+03   1.000000D-50
FLRATE1                     3.6994717000D-01   1.792400D-55
FLRATE2                     0.0000000000D+00   1.000000D-50
FLRATE3                     0.0000000000D+00   1.000000D-50
FLRATE4                     0.0000000000D+00   1.000000D-50
THRRTA1                     8.3501789000D+01   2.731100D-55
THRRTA2                     0.0000000000D+00   1.000000D-50
THRRTA3                     0.0000000000D+00   1.000000D-50
THRRTA4                     0.0000000000D+00   1.000000D-50
```

```
THRRTA5                         0.0000000000D+00    1.000000D-50
THRDEC1                         7.7018506000D+00    2.731100D-55
THRDEC2                         0.0000000000D+00    1.000000D-50
THRDEC3                         0.0000000000D+00    1.000000D-50
THRDEC4                         0.0000000000D+00    1.000000D-50
THRDEC5                         0.0000000000D+00    1.000000D-50
ENDBRN1                         2.2436700000D+02    7.479700D-01
ENDBRN                                              1.000000E-50
ENDBRN                                              1.000000E-50
ENDBRN                                              1.000000E-50
FNBEND
```

2.5.23.3 FLRATE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FLRATE0                                 5.6         .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FLRATE - Defines mass flow rate coefficients	
7	I1	Type of parameter =0 mass at T0 (Kg) =1-4 order of coefficient	
25-44	D20.8	A-priori value of derivative of the mass flow (kg/sec**order)	
45-59	D15.3	Parameter sigma	

2.5.23.4 THRRTA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRRTA1                                 0.001      .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRRTA - Defines coefficients for Thrust Right Ascension	
7	I1	- Order of coefficient	
25-44	D20.8	A-priori value (degrees)	
45-59	D15.3	Parameter sigma	

2.5.23.5 THRDEC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRDEC1                                 0.007      .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRDEC - Defines coefficients for Thrust Declination	
7	I1	- Order of coefficient	
25-44	D20.8	A-priori value (degrees)	
45-59	D15.3	Parameter sigma	

2.5.23.6 FNBEND

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FNBEND
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FNBEND - Defines the end of the FNBURN group	

2.5.23.7 ENDBRN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDBRN1                                 0.007       .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FNBEND - Defines burn termination parameters	
7	I1	- index to denote parameter =1 DT =2 DV =0 Additional parameters (3) if 7=2 (DV)	
25-44	D20.8	A-priori value (degrees)	
45-59	D15.3	Parameter sigma	

2.5.24   GPSBXW

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GPSBXW
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT           DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6          GPSBXW - Requests application and/or
                    adjustment of parameters associated with
                    the GPS satellite Box-wing TUM (Technical
                    University of Munich) model


 7      I1          Parameter Type
```

$$= 1 \quad \text{Solarpanel scale factor } \varphi \qquad \text{SEE NOTE BELOW}$$
$$= 2 \quad \text{Solarpanel rotation lag } \theta$$
$$= 3 \quad \text{Box wing X+ } (\alpha + \delta)$$
$$= 4 \quad \text{Box wing X+ } (e)$$
$$= 5 \quad \text{Box wing Z+ } (\alpha + \delta)$$
$$= 6 \quad \text{Box wing Z+ } (e)$$
$$= 7 \quad \text{Box wing Z- } (\alpha + \delta)$$
$$= 8 \quad \text{Box wing Z- } (e)$$
$$= 9 \quad \text{Y-bias}$$

```
18-24   I7          Satellite ID

25-44               A priori value

45-59               Sigma

NOTE:   The presence of one GPSBXW option for one GPS satellite will
        invoke the adjustment of ALL 9 parameters with a sigma = 1.D-30
        A-priori values equal to zero will be overwritten in GEODYN by
        default values (per block) according to the reference:

   "Adjustable box-wing model for solar radiation pressure impacting
   GPS satellites", by C.J. Rodriguez-Solano, U. Hugentobler, P. Steigenberger,
   in "Advances in Space Research, 0273-1177, 2012 COSPAR.
   Published by Elsevier Ltd, doi:10.1016/j.asr.2012.01.016.

GEODYN A PRIORI VALUES

 SPSF0    for block:   I          1.2640000000
 dthetasp for block:   I          0.0000000000
 aplusdxp for block:   I          0.5660000000
 rhoxp    for block:   I          0.4340000000
 aplusdzp for block:   I          0.3550000000
 rhozp    for block:   I          0.6450000000
 aplusdzm for block:   I          0.6280000000
 rhozm    for block:   I          0.3720000000
 yb       for block:   I          0.0000000000
 SPSF0    for block:   II         1.2350000000
 dthetasp for block:   II         0.0000000000
 aplusdxp for block:   II         0.9000000000
 rhoxp    for block:   II         0.1000000000
 aplusdzp for block:   II         0.8880000000
```

```
rhozp    for block:  II          0.1120000000
aplusdzm for block:  II          0.9170000000
rhozm    for block:  II          0.0830000000
yb       for block:  II          0.0000000000
SPSF0    for block: IIA          1.2350000000
dthetasp for block: IIA          0.0000000000
aplusdxp for block: IIA          0.9000000000
rhoxp    for block: IIA          0.1000000000
aplusdzp for block: IIA          0.8880000000
rhozp    for block: IIA          0.1120000000
aplusdzm for block: IIA          0.9170000000
rhozm    for block: IIA          0.0830000000
yb       for block: IIA          0.0000000000
SPSF0    for block: IIR          1.2783333333
dthetasp for block: IIR          0.0000000000
aplusdxp for block: IIR          1.0000000000
rhoxp    for block: IIR          0.0000000000
aplusdzp for block: IIR          1.0000000000
rhozp    for block: IIR          0.0000000000
aplusdzm for block: IIR          1.0000000000
rhozm    for block: IIR          0.0000000000
yb       for block: IIR          0.0000000000
SPSF0    for block: IIR-M        1.2783333333
dthetasp for block: IIR-M        0.0000000000
aplusdxp for block: IIR-M        1.0000000000
rhoxp    for block: IIR-M        0.0000000000
aplusdzp for block: IIR-M        1.0000000000
rhozp    for block: IIR-M        0.0000000000
aplusdzm for block: IIR-M        1.0000000000
rhozm    for block: IIR-M        0.0000000000
yb       for block: IIR-M        0.0000000000
SPSF0    for block: IIF          1.2193333333
dthetasp for block: IIF          0.0000000000
aplusdxp for block: IIF          0.8880000000
rhoxp    for block: IIF          0.1120000000
aplusdzp for block: IIF          0.8880000000
rhozp    for block: IIF          0.1120000000
aplusdzm for block: IIF          1.0000000000
rhozm    for block: IIF          0.0000000000
yb       for block: IIF          0.0000000000
```

2.5.25   HRATEF

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
HRATEF11100 0000000000          2000039.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Defines forces to use for high rate integration. For all the indices below: 0 = Force not included for HR integration 1 = Force included for HR integration	
7	I1	Index for Drag	
8	I1	Index for Solar Radiation	
9	I1	Index for General Acceleration	
10	I1	Index for Topex Thermal Radiation.	
11	I1	Index for Topex Louver Forces	
12	I1	Index for Albedo	
13	I1	Lageos Thermal Drag	
14	I1	Index for Geopotential	
15	I1	Index for Earth and Ocean Tides	
16	I1	Index for Gravity Anomalies	
17	I1	Index for Central Body Gravitation	
18	I1	Index for Third Bidy Indirect Oblation	
19	I1	Index for Mars Moons Indrrect Acceleration	
20	I1	Index for General Relativity	
21	I1	Index for Yukawa Gravity	
22	I1	Index for Planetary Moon Gravity	
23	I1	Index for Yarkovsky/Schach Acceleration	
25-44	D20.8	Satellite ID	

NOTE 1: This card is not needed to implement DSTATE modeling/estimation

IF CARD OMITTED: No forces will be used for high rate integration

2.5.26 HUBER

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
HUBER                   1.5
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT          DESCRIPTION                       DEFAULT VALUE & UNITS

1-6      A6      HUBER - Requests HUBER weighting
                 to the observations.

15-17    I3      Measurement Type that HUBER
                 weighting will apply.
                 If cols 15-17 are blank, HUBER
                 weighting will apply to all
                 Measurement types.

25-44    D20.8   C = a factor that multiplies the
                 observation sigma to create a new
                 weight. [NOTE 1]



                 NOTE [1]: With Huber weighing a user can specify a number,
                           C (1.5 is a typical specification for C). If the
                           ratio of DABS(resid_i)/sig_i is larger than C,
                           then the original weight that would have been
                           applied to that observation is multiplied by
                           C*sig_i/DABS(resid_i) to obtain the new weight
                           that is actually applied.
                           The result of this is to cause what the solution
                           is minimizing to change. The solution now minimizes
                           the combination of the sum of (resid_i/sig_i)**2
                           for all small residuals plus the sum of
                           DABS(resid_i)/(C*sig_i) for all large residuals.
                           This accommodates the larger residuals without
                           bending the solution so much towards them. The norm
                           is L2 for small residuals and L1 for large residuals.

IF CARD OMITTED:  Regular GEODYN observation weighting will be applied.
```

2.5.27 MBIAS SUBGROUP

2.5.27.1 MBIAS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MBIAS      7063 517603901 0.                  850731000000. 850831000000. 10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                       DEFAULT VALUE & UNITS


1-6      A6            MBIAS  - Requests application and/or
                       adjustment of measurement or station
                       timing bias.


7-14     I8            Station Number.                          0


15-17    I3            Bias Type. See list of bias types after  0
                       this option description.


18-24    I7            Satellite ID.                            0



OR FOR VLBI SPLINE TYPE PARAMETERS:
18-20    I3            Total number of parameters in the string
21-23    I3            Parameter number in the sequence of a string
 24      I1            Degree of spline


25-44    D20.8         Value of the bias (a priori estimate     0.
                       if adjusted). Units are:
                       Length - M, Time - S, Angles - RAD


45-59    D15.3         Date and time at which the bias is to     0.
                       begin in form: YYMMDDHHMMSS.


60-72    D13.1         Date and time at which the bias is to     0.
                       end in form: YYMMDDHHMMSS.


73-80    D8.2          Standard deviation of the a priori        0.
                       bias in the same units as bias value.
                       If this value is greater than zero bias
                       will be adjusted.



UNITS:   KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE [1]:  Please also see EBIAS and PBIAS options.

NOTE [2]: If the measurement type is larger than 99 (3 digit) use
          MBIASM card to specify it.

IF CARD OMITTED:  Measurement biases are not applied. See also EBIAS and
                  PBIAS option.
```

GEODYN-II BIAS TYPES

The GEODYN-II bias types include all of the GEODYN-II measurement types as well as other types which are independent from measurement type or which are an extension of the simple measurement bias.

At present, the only bias types defined include simple constant measurement biases and simple time biases independent of measurement type. Other future bias types will include linearly varying measurement biases, observation scale biases, tropospheric and ionospheric refraction scale biases, station clock polynomials and satellite clock polynomials.

Bias type numbers are assigned as follows:

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	STATION DEPENDENT	UNITS
simple measurement biases	measurement type	yes or	yes	
measurement scale bias	meas. type + 100	yes or	yes	
station clock bias	300	no	yes	sec
station clock linear drift	301	no	yes	sec/hour
station clock quadratic drift	302	no	yes	sec/hour^2
station clock cubic drift	303	no	yes	sec/hour^3
station clock bias (spline)	304	no	yes	sec/hour
altimeter attitude timing bias	399	yes	yes	sec
satellite clock bias	400	yes	no	sec
satellite clock linear drift	401	yes	no	sec/hour
satellite clock quadratic drift	402	yes	no	sec/hour^2
satellite clock cubic drift	403	yes	no	sec/hour^3
timing bias (only if MBIAS399 in use; see NOTE 5)	499	yes	yes	sec
tropospheric refraction scale bias	500	no	yes	[NOTE 1]
tropospheric bias zenith (spline)	501	no	yes	
tropospheric bias gradient east (spline)	502	no	yes	
tropospheric bias gradient north(spline)	503	no	yes	
ionospheric refraction scale bias	600	no	yes	
a: coefficient to TDRSS 1-way range-rate user frequency correction $\Delta f/F_{\mathrm{ref}}$	700 [NOTE 3]	yes	no	sec

F_{ref} => Reference frequency

Δf => Difference between reference
     frequency and user transmit
     frequency

frequency correction can be
specified to a cubic:

$$\frac{\Delta f}{F_{\text{ref}}} = a + b(t - t_0) + c(t - t_0)^2 + d(t - t_0)^3$$

t => Observation time
t_0 => Epoch time defined
    by the user [NOTE 2]

b: coefficient (to the linear   701   yes   no
    term)

c: coefficient (to the quadratic   702   yes   no   1/sec
    term)

d: coefficient (to the cubic   703   yes   no   1/sec**2
    term)

VLBI baseline bias   800   no   or   yes

VLBI baseline bias   NOTE [4]   801   no   or   yes

 simple time biases   900   yes   or   yes

NOTE [1]: In order to apply a troposphere refraction scale bias the parameter
         must be adjusted.

NOTE [2]: Clock polynomials (400) and TDRSS one-way correction (700)
         cannot be handled by GEODYN simultaneously.

NOTE [3]: Bias type is measurement type dependent. To specify the measurement
         type for MBIAS 700 the user should include an MBIASM card immediatlly
         following the MBIAS 700 card.

NOTE [4]: Bias type 800 represents a VLBI baseline bias. To define this we need
     to specify a second station ID. The option MBIAS 801 following
         immediately MBIAS 800 serves only for defining this station ID.
         NO OTHER information besides the station ID and the bias type 801
         is needed on the second card.

NOTE [5]: A MBIAS900 card should be used for altimeter an observation timing
         bias. A MBIAS900 card should be used for altimeter an observation
         timing bias.
         An exception to this is when a MBIAS399 card is being used for an
         altimeter attitude timing bias. I this case a MBIAS399 card and not a
         MBIAS900 card should be used.

MBIAS   7063800   0.0   850731000000.   850831000000.
MBIAS   7064801

2.5.27.2 MBIASn

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MBIAS    7063 517603901 0.                      850731000000. 850831000000. 10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

1-5     A5      MBIAS  - Requests application and/or
                adjustment of measurement or station
                timing bias.

6       A1      n - Used for estimation of multi-station      0
                and/or multi-satellite identification.
                If "n" is zero or one, then this card
                takes on the form of the "MBIAS" card.
                "n" may also take on the values two
                or three.  When this occurs, the
                station and satellite information on
                these cards ("MBIAS2" or "MBIAS3")
                augments that already provided on the
                "MBIAS" form card.

7-14    I8      Station number for the "n"th station in       0
                the measurement configuration.

15-17   I3      Bias Type. See list of measurement types      0
                after ENDARC description
                (not used if "n" equals 2 or 3).

18-24   I7      Satellite ID for the "n"th satellite in       0
                the measurement configuration.

OR FOR VLBI SPLINE TYPE PARAMETERS:
18-20   I3      Total number of parameters in the string
21-23   I3      Parameter number in the sequence of a string
 24     I1      Degree of spline


25-44   D20.8   Value of the bias (a priori estimate          0.
                if adjusted). Units are:
                Length - M, Time - S, Angles - RAD

45-59   D15.3   Date and time at which the bias is to          0.
                begin in form: YYMMDDHHMMSS.

60-72   D13.1   Date and time at which the bias is to          0.
                end in form: YYMMDDHHMMSS.

73-80   D8.2    Standard deviation of the a priori             0.
                bias in the same units as bias value.
                If this value is greater than zero bias
                will be adjusted.


UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds     ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds ; MAS=Milli-arc seconds
```

NOTE: If the time fields on cards with "n" equal to 2 or 3
       are non-zero GEODYN will internally generate a complete
       new set of MBIAS cards having the same configuration
       with different times. The bias type field will be
       ignored on MBIAS cards with "n" equal to 2 or 3.

       Please also see EBIAS and PBIAS options.

EXAMPLE FOR SAT-TO-SAT MEASUREMENTS:


```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MBIAS1         0577502701 0.                    780101000000.  780101000000.
MBIAS2    18570577403901                        780101000000.  780101000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

BIAS DESCRIPTION	BIAS TYPE NUMBER	DEPENDENT	DEPENDENT	UNITS
simple measurement biases	measurement type	yes or	yes	
measurement scale bias	meas. type + 100	yes or	yes	
station clock bias	300	no	yes	sec
station clock linear drift	301	no	yes	sec/hour
station clock quadratic drift	302	no	yes	sec/hour^2
station clock cubic drift	303	no	yes	sec/hour^3
station clock bias (spline)	304	no	yes	sec/hour
altimeter attitude timing bias	399	yes	yes	sec
satellite clock bias	400	yes	no	sec
satellite clock linear drift	401	yes	no	sec/hour
satellite clock quadratic drift	402	yes	no	sec/hour^2
satellite clock cubic drift	403	yes	no	sec/hour^3
timing bias (only if MBIAS399 in use; see NOTE 5)	499	yes	yes	sec
tropospheric refraction scale bias	500	no	yes	[NOTE 1]
tropospheric bias zenith (spline)	501	no	yes	
tropospheric bias gradient east (spline)	502	no	yes	
tropospheric bias gradient north(spline)	503	no	yes	
ionospheric refraction	600	no	yes	

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```
                                                    scale   bias

a: coefficient to TDRSS                 700 [NOTE 3]   yes          no    sec
   1-way range-rate user

b: coefficient (to the linear           701           yes          no
     term)

c: coefficient (to the quadratic        702           yes          no    1/sec
        term)

d: coefficient (to the cubic            703           yes          no    1/sec**2
        term)

VLBI baseline bias                       800           no     or    yes

VLBI baseline bias           NOTE [4]    801           no     or    yes

simple time biases                       900           yes    or    yes
```

[NOTE 1] In order to apply a tropospheric refraction scale bias the
         parameter must be adjusted.

iNOTE [2]: Clock polynomials (400) and TDRSS one-way correction (700)
        cannot be handled by GEODYN simultaneously.

NOTE [3]: Bias type is measurement type dependent. To specify the measurement
          type for MBIAS 700 the user should include an MBIASM card immediatlly
          following the MBIAS 700 card.

NOTE [4]: Bias type 800 represents a VLBI baseline bias. To define this we need
          to specify a second station ID. The option MBIAS 801 following
          immediately MBIAS 800 serves only for defining this station ID.
          NO OTHER information besides the station ID and the bias type 801
          is needed on the second card.

NOTE [5]: A MBIAS900 card should be used for altimeter an observation timing
          bias. A MBIAS900 card should be used for altimeter an observation
          timing bias.
          An exception to this is when a MBIAS399 card is being used for an
          altimeter attitude timing bias. I this case a MBIAS399 card and not a
          MBIAS900 card should be used.

```
MBIAS     7063800           0.0                         850731000000.  850831000000.
MBIAS     7064801
```

2.5.27.3 MBIASM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MBIASM100    100                                                        10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   MBIASM - This card is used when the
                        measurement type is larger than 99
                        (3 digit). The 3 digits in columns
                        7-10 will overwrite the measurement
                        type in columns 16-17 of the MBIAS
                        card. This option applies to simple
                        measurement biases and measurement
                        scale biases.

7-10   I3   Measurement Type.   0

15-17   I3   Measurement Type for TDRSS one way   0
                        range correction application. [NOTE 1]

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE [1]:   If an MBIASM card follows an MBIAS 700 card, columns 15-17
            are used to specify the measurement type for which a TDRSS
            one-way correction will apply. This correction acts like a
            scale to long link and a constant bias.

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the
                  MBIAS card.

2.5.28   MLTARC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MLTARC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	MLTARC - Requests Multi-arc data file options for arcs 2 through the number of arcs.	
7	I1	IF =0 THEN the current unit for the input 2S observation file will not be advanced.	0
		IF =1 THEN the current unit for the input 2S observation file will be advanced. [NOTE 1]	
8	I1	IF =0 THEN the current unit for the input 2S observation file will not be rewound.	0
		IF =1 THEN the current unit for the input 2S observation file will be rewound.	

NOTE [1] : Unit 40 will be advanced from the DD name of FT40F001 to
           the DD name (or file name) of ARC##, where ## is the number
           of the arc for which this option is being requested.

           Example: If this option is requested for the second arc,
                    then unit 40 will be attached to the DD name
                    ARC02.

IF CARD OMITTED: The unit 40 observation file will be read sequentially
                 for all arcs.

2.5.29 NORMPV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NORMPV1 452361  7654321             1.0D+02         1.0D-14     1.0D-12 1.0D-12
NORMPV5         7654321             1.0D-12         1.0D-12
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NORMPV - Normal point orbit adjustment control and a priori variance input.	
7	I1	Specifies elements of normal point a priori diagonal variance/covariance matrix being input on this card.	1

        1 - a,e,i & asc. node variances input in
           fields 25-44, 45-59, 60-72 and 73-80
           respectively. Parameter elimination
           order specified in columns 9-14.

        5 - arg. perigee & mean anomaly variances
           input in fields 25-44 and 45-59
           respectively. Columns 9-14 ignored.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9-14	6I1	Order in which Kepler orbit parameters are to be eliminated when using single pass orbit adjustments to edit data before normal point binning.	452361

Parameter Name	Number	Variance Units
Semi-major Axis	1	M**2
Eccentricity	2	( )**2
Inclination	3	DEG**2
R. A. of Asc. Node	4	DEG**2
Arg. of Perigee	5	DEG**2
Mean Anomaly	6	DEG**2

        Order of elimination is determined by
        parameter numbers specified in columns
        9-14, where order of elimination is
        indicated by column number minus 8.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	I7	Satellite ID.	0
25-44	D20.8	Element #1 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not be adjusted during normal point editing.	0.
45-59	D15.3	Element #2 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not be adjusted during normal point editing.	0.

```
60-72    D13.1      Element #3 of var/cov matrix as determined        0.
                    by column 7. If .LE.0 , parameter will not
                    be adjusted during normal point editing.

73-80    D8.2       Element #4 of var/cov matrix as determined        0.
                    by column 7. If .LE.0 , parameter will not
                    be adjusted during normal point editing.


Example - Diagonal elements of Keplerian variance/covariance matrix.

 1-6     7  9 - 14      18-24       25-44       45-59       60-72       73-80
NORMPV   1   452361     7654321      V11         V22         V33         V44
NORMPV   5              7654321      V55         V66


NOTES:   The parameters specified on this card have no effect on the actual
         orbit adjustment process.  They are used only in single pass orbit
         parameter adjustments used to edit data prior to the formation of
         normal points on the last inner iteration of the last global
         iteration.

         The Global Set option card NORMPT must be exercised if normal points
         are to be generated.

UNITS:   KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
         DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds
         ( )=Unitless

IF CARD OMITTED: Diagonal matrix with values as follows will be used:
V11=1.0D2, V22=1.0D-14, V33=1.0D-12, V44=1.0D-12, V55=1.0D-12, V66=1.0D-12
```

2.5.30   VLBI SUBGROUP

2.5.30.1 OPVLBI

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OPVLBI
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                         DEFAULT VALUE   UNITS

  1-6      A6         OPVLBI: Denotes the beginning of the VLBI options
```

2.5.30.2 VLBSTR

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
VLBSTR
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                        DEFAULT VALUE   UNITS

  1-6      A6         VLBSTR

    8      I1         Index for option (1,8)

 11-74     A64        Body of the string
```

2.5.30.3 ENDOPV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDOPV
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                             DEFAULT VALUE   UNITS

  1-6    A6         ENDOPV: Denotes the end of the VLBI options.
```

2.5.31 ORBFIL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ORBFIL            6302610 840201080000.       840201090000. 10.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests output of trajectory file(s) on specified unit(s) on the last iteration of the run.	
7	I1	Coordinate system of output	
		0 - True of date (default)	0
		1 - True of reference date	
		2 - Mean of year 2000	
8	I1	Switch indicating whether trajectory file	0
		is for a single satellite or a set of satellites.	
		0 - Single satellite	
		1 - Set of satellites. This option has meaning only when used in conjunction with sets of satellites (See EPOCH and SLAVE option cards for more details). If satellite ID in columns 18-24 is a master satellite, then the trajectory for all satellites in the set will be output.	
9-11	I3	Mandatory unit number for trajectory file. All trajectory files within an arc must have unique unit numbers. The suggested unit number starts at 130. [3]	0
12	I1	Option to convert cgmass in sbf to tor frame	0
		0 - Center of mass (default)	
		1 - Center of figure	
18-24	I7	Satellite ID. This field must contain a valid ID.	0
25-44	D20.3	Start date and time for trajectory output (YYMMDDHHMMSS.SS).	No Default
45-59	D15.3	Stop date and time for trajectory output (YYMMDDHHMMSS.SS).	No Default
60-72	D13.1	Time interval between successive trajectory outputs.	0 S

NOTES:

    [1]: In multiple satellite runs (like GPS runs), a separate ORBFIL
           option card is needed for each satellite. The same start and
           stop times on each card should be used.

    [2]: If master satellite and its slaves are output as a set (column
           8=1), individual members of the set may still be output in
           separate files by including separate ORBFIL card(s) for the
           desired satellite(s).

    [3]: The user can place in column 9-11 values between 130 and 230 without
           over-writting any 2E output units.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
       DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No trajectory output file will be generated.

2.5.32 ORBINF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ORBINF15                841101000000.       841108000000.  300.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ORBINF - Requests ORBINF file (station/satellite look angles) be generated for the indicated stations and time period.	
7-8	I2	Number of stations (N) to be included in the ORBINF file. The first N stations in the GEODETICS file will used first. If N is larger than the number of stations in the GEODETICS file then stations from the STAPOS subgroup will be used. The maximum number of stations (N) allowed is 15.	
18-24	I7	Satellite ID.	
25-44	D20.8	Start date and time for ORBINF output. (YYMMDDHHMMSS.SSSSS) (NOTE 1)	
45-59	D15.3	End date and time for ORBINF output. This end date MUST be less than or equal to the stop date specified on the epoch card. (YYMMDDHHMMSS.SS) (NOTE 1)	
60-72	D13.1	Interval for station/satellite look angle generation in integral seconds.	

NOTE [1]: All times specified on any arc option cards must fall between the
          earlier of the epoch and start time and end prior to or at the stop
          time specified on the epoch card.

 IF CARD OMITTED: No ORBINF file will be created.

2.5.33 ORBTVU

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ORBTVU1          6302610650630180000.        650708000000.  3600.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests trajectory printout. Cartesian elements on unit 8 and Keplerian elements on unit 10. Use an ORFIL card for trajectory file generation. Required in orbit generation runs, optional in data reduction runs. [NOTE 4]	
7	I1	Frequency of trajectory output.	0
		0 - Trajectory output viewed between times specified in columns 25-59 and at interval specified in columns 60-72.	
		1 - Trajectory output viewed between times specified in columns 25-59 at data points only.	
		2 - Trajectory output viewed between times specified in columns 25-59 at data points and at the interval specified in columns 60-72.	
8	I1	Coordinate system of output	0
		0 - True of date	0
		1 - True of reference date	
		2 - Mean of year 2000	
9	I1	Trajectory type indicator.	0
		0 - Cartesian ephemeris	
		1 - Keplerian ephemeris	
		2 - Both Cartesian and Keplerian ephemerides.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Iterations on which trajectory will be printed.	0
		0 - First arc iter of first global iter	
		1 - Last arc iter of last global iter	
		2 - Both first first and last last	
		3 - All iterations	
18-24	I7	Satellite ID. If not specified applies to all S/C in arc.	0

```
25-44    D20.3      Start date and time for trajectory
                    viewing (YYMMDDHHMMSS.SS).    [NOTE 3]

45-59    D15.3      Stop date and time for trajectory
                    viewing (YYMMDDHHMMSS.SS). [NOTE 3]

60-72    D13.1      Nominal interval between successive        0.      S
                    trajectory viewings.



NOTE 1:  Cartesian elements are printed on unit 8 and Keplerian elements
         are printed on unit 10.

NOTE 2:  Orbit generation mode (ORBGEN mode) is implied by the lack of a
         DATA card or simulated data generation (SIMDAT) card.

NOTE 3:  Start and stop dates are required. There are no defaults.

NOTE 4:  For an orbit generation run, the users should make sure that
         all arc parameters have zero sigmas. Orbit generation with
         arc parameter estimation request are incompatible in GEODYN.

UNITS:   KM =Kilometers; M  =Meters     ; S  =Seconds     ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds



IF CARD OMITTED: No trajectory output will be generated
```

2.5.34 PANEL

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
PANEL   0  1 1   7521345                1.0E0          0.0E0          0.0E0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PANEL - Requests application and/or adjustment of parameters associated with a flat panel for use in nonconservative force modeling.	
9	I1	Panel motion indicator	0

        0 - Panel is fixed in satellite
           body-fixed coordinates
        1 - Indicates a movable Panel with respect
           to the spacecraft body fixed frame
           (ie. the TOPEX solar array).
           [NOTE 1]

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Index for the type of frequency received by the panels	

    =0 panel receives both short wave and long wave radiation (default)
    =1 panel receives short wave radiation
    =2 panel receives long wave radiation

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
11-12	I2	Indicates panel number	1
13-14	I2	Parameter type	

        1 - Normal vector in body-fixed
           coordinates
        2 - Area   0.   m**2
        3 - Specular reflectivity   0.
        4 - Diffuse reflectivity   0.
        5 - Emissivity   0.   K
        6 - Temperature A
           (cold equilibrium temperature)
        7 - Temperature C   0.   K
           (delta temperature between hot and
            cold equilibrium temperature)
        8 - Temperature decay time D   0.   Sec.
           (exponential decay time for panel
            cooling)
        9 - Temperature decay time F   0.   Sec.
           (exponential decay time for panel
            heating)

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS

       10 - Temperature/satellite rotation X   0.
           (divisor for cos(theta) term in
            heating equation)

```
18-24    I7          Satellite ID (required).                        0

25-44    D20.8       Apriori parameter value as dictated in
                     columns 13-14. (X component of normal vector
                     if 1 is specified in columns 13-14)

45-59    D15.3       Apriori parameter sigma as dictated in
                     columns 13-14. (Y component of normal vector
                     if 1 is specified in columns 13-14)

60-72    D13.1       Z component of panel normal vector
                     (if 1 is specified in columns 13-14)

NOTE [1] : Movable panels must be grouped after the non-movable panels,
           and in ascending order.
```

2.5.35   PBIAS

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
PBIAS      9001 517603901  1.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PBIAS - Requests adjustment of pass by pass measurement or timing biases. [Note 2]	
7-14	I8	Station Number.	0
15-17	I3	Bias Type. See list of bias types after this option description.	0
18-24	I7	Satellite ID.	0
25-44	D20.8	A priori bias value. Units: Length - M, Time - S, Angles - RAD	0.
45-59	D15.3	Start date and time for generating pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.
60-72	D13.1	End date and time for generation of pass by pass biases. (YYMMDDHHMMSS). See NOTE 1.	0.
73-80	D8.2	Standard deviation of the a priori bias in the same units. This field must be a non-zero.	

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

NOTE [1]: If the start and end dates are left blank pass by pass biases
          will be generated for the entire data span.

NOTE [2]: Warning. If the PBIAS option is used with the PUNCH option,
          MBIAS cards are generated from the PBIAS option. This means
          that the original PBIAS cards must be removed from the
          setup if the MBIAS cards generated by the PUNCH option are
          used in the next run.

NOTE [3]: If the measurement type is larger than 99 (3 digit) use
          the PBIASM card to specify it.

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	STATION DEPENDENT
simple measurement biases	measurement type	yes or	yes
measurement bias varying linearly with time	meas. type + 100	yes or	yes
measurement scale bias	meas. type + 200	yes or	yes
tropospheric refraction	500	no	yes

```
  scale bias

ionospheric refraction            600      no          yes
  scale bias

simple time biases                900      yes   or    yes

clock frequency bias              901      yes   or    yes

clock frequency drift             902      yes   or    yes
```

2.5.36   PBIASM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
PBIASM      100
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   PBIASM - This card is used when the
                    measurement type is larger than 99
                    (3 digit). The 3 digits in columns
                    15-17 will overwrite the measurement
                    type in columns 16-17 of the PBIAS card.
                    Requests adjustment of pass by
                    pass measurement or timing biases.

15-17   I3   Measurement Type.   0

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the
                  PBIAS card.

2.5.37 PENUMB

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+---8
PENUMB          7603901
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   PENUMB   - Invoke the   R.Robertson's Penumbra model
                    for the satellite on columns 18-24

18-24   I7   Satellite ID.   0

2.5.38   RELTMC

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
RELTMC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT        DESCRIPTION                        DEFAULT VALUE & UNITS

1-6      A6          RELTMC - Requests application of the
                     range correction due to relativistic
                     periodic and secular space craft clock
                     drift. [1],[2],[3],[4],[5]

7        I1          Type of satellite

                        0 - Not GPS - applies secular and
                            periodic correction
                        1 - GPS  - applies periodic correction only

25-44    D20.8       Satellite ID

45-59    D15.3       Satellite ID

60-72    D13.1       Satellite ID

73-80    D8.2        Satellite ID
```

NOTES:
  [1] If no satellite ID's are specified, card applies to all satellites in run.

  [2] The user may request application of this correction for up to four
      satellites on one card. (A maximum of 30 satellites for this option
      can be requested)

  [3] The relativistic time correction applies to the following measurement
      types: 39, 40, 41, 42, 55, 56.

  [4] A PREPRO card must be present in order for the correction to be applied
      The contribution of this correction is summed into the total relativistic
      measurement correction which can be printed on unit 16.

  [5] Currently, GEODYN uses the first point in the block to compute the semi-
      major axis, and also utilizes the time of the block start for the
      sychronization time. Because of this, you may get slightly different
      results if you change the blocking of your run.

IF CARD OMITTED: No relativistic time correction will be applied.

2.5.39   RESIDU

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
RESIDU
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	RESIDU - Requests residual file output on unit 19 on the last inner of the last global iteration.	
7	I1	Event times/location data switch.	0
		0 - Residual file will not contain event times or trajectory information.	
		1 - Requests event times and spacecraft trajectory or true pole station locations at those event times be output along with the residual information. Trajectory output is in the true of data coordinate system.	
8		Observation data switch.	0
		0 - Residual file will not contain observation data.	
		1 - Requests observation data be output along with the residual information.	
		2 - Requests observation data and observation correction data be output along with the residual information.	

IF CARD OMITTED: No Residual File will be generated.

2.5.40 ROCK4

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ROCK4
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ROCK4 - Requests application of the ROCK4 or ROCK42 solar radiation model. [2]	
9-10	I1	Newer thermal model = 0 Older thermal model = 1	0
25-44	D20.8	Satellite ID	
45-59	D15.3	Satellite ID	
60-72	D13.1	Satellite ID	
73-80	D8.2	Satellite ID	

NOTES : [1] If no satellite ID's are specified, card applies to all satellites
            in run.

        [2] The user may request application of this solar radiation model
            for up to four satellites on one card (A maximum of 30 satellites
            can be requested).

        [3] The new version of the rock4 solar radiation model came from
            a paper given by H.F.Fliegel and T.E.Gallini at the AGU
            30May91 where for BLOCK I satellites X and Z are as follows

                X=-4.55SIN(B)+.08SIN(2B+.9)-.06COS(4B+.08)+.08
                Z=-4.54COS(B)+.20SIN(2B-.3)-.03SIN(4B)

            For BLOCK II satellites, X and Z are

                X=-8.96SIN(B)+.16SIN(3B)+.10SIN(5B)-.07SIN(7B)
                Z=-8.43COS(B)

            For BLOCK IIR satellites, X and Z are

              X=-11SIN(B)-0.2SIN(3B)+0.2SIN(5B)
                Z=-11.3COS(B)+0.1COS(3B)+0.2COS(5B)

        [4] This card is used in conjunction with SOLRD card.

      [5] The satellite ID for BLOCK I satellites must end in "1", for
          BLOCK II satellites in "2", and for BLOCK IIR satellites in "3".

IF CARD OMITTED: ROCK4 or ROCK42 models will not be applied.

2.5.41 SLFSHD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SLFSHD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS


1-6      A6          SLFSHD  Requests application of a self
                     shadowing effect to non conservative models
                     (drag, solar radiation) due to the shadowing
                     of the S/C macromodel plates on each other.
  7      I1          =0 Use ascii shadowing file
                     =1 Use binary shadowing file


  8      I1          Shadowing application index.
              =0 Do not use shadowing on this satellite
              =1 Use shadowing for this satellite


9-10     I2          Force application index
              =11 Use shadowing for both Solar Radiation
              and Drag
              =10 Use shadowing for Solar Radiation only
              =01 Use shadowing for Drag only.


18-24    I7          Satellite ID.                              0




UNITS:   KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
         DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED:  Self shadowing will not be applied on any satellite.

THE DATA STRUCTURE FOR SHADOWING FILE

One shadowing file should be used for each satellite. Each shadowing file should
have one general header record and one or two blocker header record. The block
header record must be followed by data records. The shadowing file could be
either ascii or binary file.

ASCII SHADOWING FILE
General Header Record: four integers
1: number of blocks
2: number of panels for this satellite
   This number must match the panel cards in the IIS setup file.
3: model indicator
   0 for ratio
   1 for actual cross-section
4: satellite ID number
Block Header Record: one integer followed by three real numbers
1 (integer): block indicator
             0 for solar radiation
             1 for drag
2 (real):    start time in UTC YYMMDDHHMMSS.SS format
3 (real):    stop time in UTC YYMMDDHHMMSS.SS format
4 (real):    time step in seconds
Data Record:
Each data record includes the time tag followed by the values for each panel.
```

BINARY SHADOWING FILE
The binary has exactly the same structure as the ascii shadowing file. One
should be careful that the size of integers in binary file should be consistent
with the GEODYN versions (i32 or i64).

Note if one wants to use binary shadowing file and has multiple satellites, one
must set the 7th columns on all the SLFSHD cards to 1, otherwsie GEODYN IIS will assume
ascii shadowing files shall be used for all the satellites. In other words, one
could only use either ascii or binary files simultaneously for all those satellites.

2.5.42 SIMULATION DATA SUBGROUP

2.5.42.1   SIMDAT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMDAT 0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMDAT - Requests output of simulated data to UNIT 20 on final iteration. Actual data replaced with calculated value from final iteration. The simulated data is in the GEODYN II binary format expected by UNIT 40 of IIS.	
8	I1	Simulated data generation indicator.	
		=0 Simulated data will be generated by replacing real data with computed data.	
		=1 Data will be simulated for measurement types and times as specified on the SIMDAT control cards following this SIMDAT card. The SIMDAT control cards may be input as a separate file in UNIT17.	
10	I1	Indicator specifying the input file of the SIMDAT control cards.	
		=1 SIMDAT control cards are input on UNIT17	
		Please see NOTE [1] below	

NOTE [1]: This Option is not yet available for all measurement types.
For the time being only range and range rate, altimetry
and angle measurement types can be simulated. For paired
angle measurement types read the note on the SIMTYP card.

IF CARD OMITTED: No data will be simulated.

2.5.42.2 SIMDAT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMDAT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SIMDAT: A blank SIMDAT card in the
                   beginning of UNIT17 introduces the
                   simulated data generation mode
                   specification subgroup which may
                   include up to 20 configurations and
                   ends with the ENDSIM card.

                   Each individual configuration includes
                   the following cards:

                           SIMSAT
                           SIMSTA
                           SIMTIM   This group must be repeated with
                           SIMTYP   each individual configuration.
                           ENDCON

NOTE: For further details see individual card descriptions in the following
      pages and Section 3.1.7 and see sample setup in APPENDIX Example 7.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and
                 this card is missing the run will terminate.

2.5.42.3 SIMLIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMLIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMLIM: Requests certain limitations for the simulated data generation mode	
7-14	I1	Index to orbit pattern choice:	0
		=0 all orbits as defined by the following input cards.	
		=1 only ascending orbits	N / A
		=2 only descending orbits	N / A
31-45	D15.8	The interval between "observations" The same interval will be used as counting interval in all measurement types involving distruct Doppler data.	S
46-60	D15.8	Visibility checking time interval	N / A
61-70	D10.2	Elevation cutoff angle below which no data will be generated.	DEG 0

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and
                 this card is missing the run will terminate.

2.5.42.4 SIMSAT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMSAT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & UNITS


1-6     A6              SIMSAT: Defines a set of satellites
                        involved in the present configuration.
                        SIMSAT and the following SIMSTA cards
                        defines a tracking configuration
                        in simulated data generation mode.

7-14    I8              Satellite ID for the tracked satellite in this
                        configuration.

15-22   I8              Satellite ID for the relay satellite in this
                        configuration.

23-30   I8              Satellite ID for the third satellite in this
                        configuration.



NOTE: For all the satellites involved there must be an equivalent
      SATPAR card on UNIT 5. For any given configuration (measurement)
      GEODYN is limited to a maximum of three satellites and three
      stations.



IF CARD OMITTED: If simulated data generation (not replacement) is
                 invoked and this card is missing the run will terminate.
```

2.5.42.5 SIMSTA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMSTA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SIMSTA: Defines a set of stations involved
                        in the present configuration.

7-14   I8   Receiving station number
                        No station number is required for
                        altimetry data generation.

15-22   I8   Transmitting station number.

23-30   I8   Third station number.

NOTE: For all the stations listed on this option card there must be
        corresponding station coordinates in the STAPOS subgroup.

IF CARD OMITTED: If simulated data generation (not replacement) is
                 invoked and this card is missing for measurement
                 types where stations are involved, the run will
                 terminate.

2.5.42.6 SIMTIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMTIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMTIM: Start and end time for simulated data generation for the tracking configuration defined on the previous SIMCON card and for the types defined on the previous SIMTYP cards.	
31-45	D12.	Start date in form YYMMDDHHMMSS.	Earliest start date and time from EPOCH cards on UNIT5
46-60	D12.	Stop date in form YYMMDDHHMMSS.	Latest stop date and time from EPOCH card on UNIT5
61-70	I10	Elevation cutoff angle,overrides any values on SIMLIM cards	Value from SIMLIM card.
71-80	I10	Surface elevation for altimetry data	N / A

IF CARD OMITTED: Run will abnormally terminate.

2.5.42.7 SIMTYP

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIMTYP
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   SIMTYP: Data for the measurement type
                       described on this card will be generated
                       for the tracking configuration defined
                       on the preceding SIMSAT and SIMSTA cards.
                       [NOTE 1]

12-14   I3   Measurement type. (See Section 5.0 for
                       discussion on measurement types.

31-45 D15.8   Measurement noise level, for 1st   0
                       measurement.   [NOTE 2]

46-60 D15.8   Measurement noise level, for 2nd   0
                       measurement. (in case of paired
                       measurements) [NOTE 2]

61-70 D10.2   Observation time interval   Value from   S
                                                          SIMLIM card.

NOTE [1] : For simulating paired measurement types the user should only
           specify the first measurement in the pair i.e. 17 for the
           pair 17-18. GEODYN will automatically simulate both. This
           convention applies for all measurement types between 17 and 30.

NOTE [2] : For the noise level use the same units as the observations (M or
           or M/Sec for metric type, DEG RAD or MAS for angles). For each
           observation the noise level will be multiplied by a random number
           between -1 and 1.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If simulated data generation (not replacement) is
                 invoked and this card is missing the run will
                 terminate

2.5.42.8 ENDCON

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDCON
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   I6   ENDCON: End of configuration
                    Will be followed by an ENDSIM card
                    if this is the last configuration.
                    Will be followed by a SIMSAT card
                    if another configuration is requested.

IF CARD OMITTED: If simulated data generation (not replacement) is
                 invoked and this card is missing the run will
                 terminate.

2.5.42.9 ENDSIM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDSIM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ENDSIM: End of the simulated data
                      input cards

IF CARD OMITTED: If simulated data generation (not replacement) is
                 invoked and this card is missing, the run will
                 terminate.

2.5.43 SOLRAD

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
SOLRAD 0        7654321 1.5
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SOLRAD - Requests application and/or adjustment of solar radiation pressure.	
8	I1	Indicates order of radiation pressure coefficients.	0

        0 - Cr

          .

        1 - Cr

          ..

        2 - Cr

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
9	I1	=1 The UCL solar radiation bus model will be used for JASON =2 The UCL solar radiation model will be used for GFO =3 The UCL solar radiation model will be used for ENVISAT	
10	I1	=1 The UCL solar radiation panel model will be used for JASON	
11	I1	=1 The UCL re-radiation panel model will be used for JASON	
14	I1	Sunlight Ratio input =1 Sunlight Ratio input will be read from UNIT 77 and will be used instead of the ratio being calculated in SOLRAT =0 SOLRAT will calculate Sunlight Ratio See NOTE(2) for more details.	0
18-24	I7	Satellite ID.	0
25-44	D20.8	Solar radiation pressure coefficient. (Units for Cr dot and Cr double dot are per second and per second squared)	0. none or 1/S or 1/S**2
45-59	D15.3	This field must be left blank unless the time dependent solar radiation option is wanted. To select time dependent solar radiation the end time of the period for which this acceleration coefficient applies is input in the form YYMMDDHHMMSS.SS in this field. See NOTE(1) for more details.	0.
60-72	D13.1	Standard deviation of radiation pressure coefficient.	0. none or 1/S or 1/S**2

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees    ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds


NOTE[1]: Time periods may be specified only for the highest order coefficients
         used (i.e. if Cr and Cr dot are used, only Cr dot can have time
         intervals). When using time periods the number of SOLRAD cards
         required is equal to the number of time periods plus the order (order
         = the number in column 8 +1). The Cr, Cr dot, and/or Cr double dot
         without a time interval are used for times beyond the end of the
         the last interval specified on the SOLRAD cards. See example on
         next page.




 EXAMPLE:  SOLRAD cards for using time dependent general accelerations
           (highest order - Cr ;three time intervals;  4 cards required)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SOLRAD 0         7654321 1.5
SOLRAD 0         7654321 1.51                      840901000000.
SOLRAD 0         7654321 1.52                      840902000000.
SOLRAD 0         7654321 1.53                      840903000000.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0




NOTE[2]: The input file should have the following structure:

         MAIN HEADER
         Contains Number of Satellites
         FORMAT(I2)

         SUBHEADERS
         One subheader for each satellite.
         Contains Satellite ID and Number of observations (observations
         being when the SC is transitioning to/from the sunlight/shadow)
         FORMAT(I7,1X,I6)

         TITLE HEADER for Satellite 1
         Just a title reading SATELLITE 1 DATA

         DATA
         Data includes times and sunlight ratios immediately before,
         during, and immediately after the spacecraft transitions to/from
         full sunlight.
         During the transitions, data should be at regular time intervals.
         Time is in UTC.
         Data is in the following structure:
         Time    Ratio
         FORMAT(F14.3,1X,F6.4)

         This is followed by the TITLE HEADER and DATA of remaining satellites.

 EXAMPLE:  The following is a portion of input for two satellites, where
           there are 9245 observations for each satellite 2012001 and
           satellite 2012002. A line of stars represent a jump in the input.
```

```
         2
        2012001    9245
        2012002    9245
         SATELLITE 1 DATA
        2245277866.791 1.0000
        2245277871.791 0.7663
        2245277876.791 0.3945
        2245277881.791 0.1352
        2245277886.791 0.0000
        2245280541.886 0.0000
        2245280546.886 0.3428
        2245280551.889 0.6467
        2245280556.889 1.0000
        ********************
         SATELLITE 2 DATA
        2245277866.791 1.0000
        2245277871.791 0.7663
        2245277876.791 0.3945
        2245277881.791 0.1352
        2245277886.791 0.0000
        2245280541.886 0.0000
```

WARNINGS: If duplicate time periods are specified the run will terminate
          in IIS with a warning message.
          The first time period that exceeds the end time of the run
          (see EPOCH card) will be accepted. All other end times exceeding
          the end time of the run will be ignored.

2.5.44 STEP

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
STEP              7654321 45.                  45.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STEP - Changes integrator order and step size.	
7-8	I2	Order of integration for orbit.	11
9-10	I2	Order of integration for variational	Same as orbit
11-12	I2	Number of output buffers to save integration information.	
14	I1	>1 For this satellite we need to write integration information out for later use.	0
15-17	I3	Millions of words devoted to this satellite in dynamic arrays for integration information.	
18-24	I7	Satellite ID.	0
25-44	D20.8	Step size for orbit integration.	60. S
45-59	D15.3	Step size for variational equations.	Same as orbit
60-72	D13.1	Small stepsize used for variable size integration step.	1. S

NOTE 1: If the DSTATE option is in the setup, variable intergration is
        required. Columns 60-72 need to be filled in with appropriate
        step size.

NOTE 2: Multirate integration should be used for the DSTATE option (note 1)
        or when it is desired to numarically integrate some forces at a
        smaller step size than others. When dividing forces into different
        step sizes the HRATEF card should be used. There is no reason to
        use the HRATEF card if multi-rate integration is being used only
        for the purpose of modeling/estimating DSTATE parameters.

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

**2.5.45  TATBIA**

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TATBIA                                          0.0             0.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6              TATBIA - Defines biases in the solar
                         array pitch and spacecraft yaw
                         for satellites other than TOPEX.

18-24    I7              Satellite ID

25-44    D20.8           Solar array pitch bias   [NOTE 1]              0.0      deg
```

```
NOTE [1]:

           The solar array pitch bias applies to the time period
           specified on the TATBTM card which immediately follows this card.
           If no TATBTM card immediately follows this card the time period
           will be taken from the EPOCH card.
           Multiple TATBIA cards may be included in a run. The time periods on
           corresponding TATBTM cards should not overlap. If there is no
           solar array pitch bias specified for a certain time period the
           default value applied will be zero.
```

2.5.46   TATBTM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TATBTM                                      0.0           0.0
----+----0----+----0----+----0----+----0---+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   TATBTM - Specifies the start and stop
                       times for the solar array pitch bias
                       on the TATBIA card immediately before
                       this card.

25-44   D20.8   Start time for solar array pitch value   none
                       specified on TATBIA card immediately
                       before this card. (YYMMDDHHMMSS.SS)

45-59   D15.3   Stop time for solar array pitch value   none
                       specified on TATBIA card immediately
                       before this card. (YYMMDDHHMMSS.SS)

IF CARD OMITTED: The time period applied to the TATBIA card will be
                  taken from the EPOCH card.
```

2.5.47 TELEM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TELEM
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests output of TOPEX telem file on unit 97 on the last iteration of the run.	
18-24	I7	Satellite ID of the LEO in a GPS run. This input will invoke a special TELEM output on unit 97 for the LEO on the last iteration. A GPSMOD option is also required in the same setup for this option to work. The absence of the satellite ID will cause TELEM to work normally with attitude and panel output information.	0

IF CARD OMITTED: No TOPEX telem file will be generated.

2.5.48 THRDRG

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRDRG          7603901
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRDRG - Requests thermal drag application.	
7		Card number indicator (1 or 2). The second card is used to request adjustment of the satellite spin axis.	1
8	I1	> 0 Indicates that partials are to be calculated but the thermal drag force will not be applied.	0
18-24	I7	Satellite ID (Required)	0
25-44	D20.8	Scaling parameter D (see model below)	-11.836**-12 MS**-2
45-59	D15.3	Model variable parameter ζ (see model description below)	1.2 unitless
60-72	D13.1	Colatitude of the satellite's spin axis θ If there is a 2 in column 7 (if this is the second THRDRG card), then this field is for the standard deviation of the a priori spin axis colatitude. The default standard deviation is zero.	22 DEG
73-80	D8.2	The right ascension of the satellite's spin axis λ If there is a 2 in column 7 (if this is the second THRDRG card), then this field is for the standard deviation of the a priori spin axis right ascencion. The default standard deviation is zero.	313 DEG

Note [1]: The option to adjust the spin axis will not work in a run with more than one satellite or more than one arc.

Note [2]: The thermal drag acceleration is computed from the equation (for detailed description see section 8.12, Vol. 1):

$$\vec{a}_{\mathrm{TD}} = \left[\frac{-D(\vec{r}_d \cdot \vec{S})}{\sqrt{1+\zeta^2}} \right] \vec{S}$$

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; M/S=Meters per second

```
          DEG=Degrees    ; RAD=Radians    ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED : Thermal drag acceleration will not be included.

2.5.49 TIEOUT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+---8
TIEOUT                    931224000000.00
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION		DEFAULT VALUE & UNITS
1-6	A6	TIEOUT - Used to request TIEOUT information be written at end of parameter labels record of emat.		
25-44	D20.8	Output request epoch		YYMMDDHHMMSS.SS
45-59	D15.3	Reference coordinate system date of output defaulted to value in columns 26-44.	cols. 26-44	YYMMDDHHMMDD.SS

2.5.50 TOPATT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TOPATT  2         9606123   960701112233.00000 960702112233.0          90.0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

1-6      A6             TOPATT - Requests override of nominal
                               TOPEX yaw steering algorithm.

9        I1             Yaw steering mode indicator                  0

                           1 - Sinusoidal yaw
                           2 - Fixed yaw
                           3 - Ramp Up
                           4 - Ramp Down
                           5 - Geocentric pointing

18-24    I7             Satellite ID (required).                     0

25-44    D20.3          Start time of yaw steering event.
                        YYMMDDHHMMSS.SS
                        [See Note 1]

45-59    D15.3          Stop time of yaw steering event.
                        YYMMDDHHMMSS.SS
                        [See Note 1]

60-72    D13.1          Satellite fix yaw angle (mode 2)             0  (deg)


NOTE 1  :   TOPATT cards must be in ascending time order.


IF CARD OMITTED:    TOPEX will follow nominal yaw steering algorithm.
```

2.5.51 TOPBIA

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TOPBIA                                      0.0             0.0
----+----0----+----0----+----0----+----0---+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT        DESCRIPTION                      DEFAULT VALUE & UNITS

1-6      A6            TOPBIA - Defines biases in the solar
                       array pitch and spacecraft yaw
                       for the TOPEX satellite.

25-44    D20.8         Solar array pitch bias  [1]                0.0  deg

45-59    D15.3         Yaw bias                                   0.0  deg
```

```
NOTE [1]:

         The solar array pitch bias applies to the time period
         specified on the TOPBTM card which immediately follows this card.
         If no TOPBTM card immediately follows this card the time period
         will be taken from the EPOCH card.
         multiple TOPBIA cards may be included in a run. The time periods on
         corresponding TOPBTM cards should not overlap. If there is no
         solar array pitch bias specified for a certain time period the
         default value applied will be zero.
```

2.5.52   TOPBTM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TOPBTM                                           0.0           0.0
----+----0----+----0----+----0----+----0---+----0----+----0----+----0----+----0
```

COLUMNS   FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   TOPBTM - Specifies the start and stop
                        times for the solar array pitch bias
                        on the TOPBIA card immediately before
                        this card.

25-44   D20.8   Start time for solar array pitch value   none
                        specified on TOPBIA card immediately
                        before this card. (YYMMDDHHMMSS.SS)

45-59   D15.3   Stop time for solar array pitch value   none
                        specified on TOPBIA card immediately
                        before this card. (YYMMDDHHMMSS.SS)

IF CARD OMITTED: The time period applied to the TOPBIA card will be
                   taken from the EPOCH card.
```

## 2.5.53 TOPLOV

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TOPLOV
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPLOV - Requests application of an acceleration due to thermal radiation emmitted from the louvers on the TOPEX spacecraft.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Magnitude of the acceleration in the TOPEX body fixed frame. component of normal vector if 1 is specified in columns 13-14)	0 m/s**2
45-59	D15.3	X component of normal vector of the acceleration in the TOPEX body-fixed frame.	
60-72	D13.1	Y component of normal vector of the acceleration in the TOPEX body-fixed frame.	
73-80	D15.3	Z component of normal vector of the acceleration in the TOPEX body-fixed frame.	

If card ommitted: no louver accceleration will be applied.

2.5.54 TOPYAW

```
----+----1----+----2----+----3----+----4---+----5----+----6----+---7----+---8
TOPYAW             9601123                   15.0              0.1       80.00
----+----0----+----0----+----0----+----0---+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6          TOPYAW - Defines betaprime boundaries
                     marking changes in yaw steering mode
                     for the TOPEX satellite.

  10     I1              =1 Default for the following Beta prime values
                            is zero
                         =0 Default for the following Beta prime values
                            are indicated below

18-24    I7          Satellite ID

25-44    D20.8       Betaprime value marking the boundary between      15.0   deg
                     fixed yaw at low betaprime and sinusoidal yaw

45-59    D15.3       Betaprime value marking the boundary between       0.1   deg
                     fixed yaw and the flip manuever

60-72    D13.1       Betaprime value marking boundary between          80.0   deg
                     sinusoidal and fixed yaw at high betaprime
                     if 1 is specified in column 10
```

2.5.55 TSTLOV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
TSTLOV
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TSTLOV - Requests application of an acceleration due to thermal radiation emmitted from the louvers on spacecrafts other than TOPEX.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Magnitude of the acceleration in the space- craft body fixed frame. component of normal vector if 1 is specified in columns 13-14)	0 m/s**2
45-59	D15.3	X component of normal vector of the acceleration in the spacecraft body-fixed frame.	
60-72	D13.1	Y component of normal vector of the acceleration in the spacecraft body-fixed frame.	
73-80	D15.3	Z component of normal vector of the acceleration in the spacecraft body-fixed frame.	

IF CARD OMITTED: no louver accceleration will be applied.

2.5.56 TUMSOL

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
TUMSOL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT        DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6            TUMSOL - Introduces the application of
                      the TUM (Tehcnical University of MUNICH)
                      solar radiation model. (only applicable to
                      GPS satellites)

7       I1            = 0 The model will apply to all satellites
                      = 1 The model will apply to the satellite on
                          on columns 18-24

8       I1            = 1 Return complete solar radiation acceleration    1
                      = 2 Return only the solar orientation bias

9       I1            = 1 Return contribution of Y-bias acceleration      2
                      = 2 Exclude Y-bias acceleration

18-24   I7            Satellite ID
```

2.5.57   VARCOV

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
VARCOV  0 10     7654321                 1.0D+14         1.0D+14      1.0D+14 1.0D+14
VARCOV  0 11     7654321                 1.0D+14         1.0D+14
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	VARCOV - A-priori variance/covariance matrix for the satellite epoch elements.	
8	I1	Indicator of coordinate system of adjustment. 0 or 1 - Cartesian. 2 - Keplerian. 3 - Low e and i (Non-singular Keplerian).	0
9	I1	Indicates whether diagonal or upper triangular part of matrix will be input. 0 - Diagonal elements only. 1 - Upper triangular matrix.	0
11-12	I2	Card identifier (REQUIRED) (see examples next page).	0
18-24	I7	Satellite ID. (blank or zero means apply to all satellites.	0
25-44	D20.8	Element #1 of var/cov matrix as determined by column 11. [1]	0.
45-59	D15.3	Element #2 of var/cov matrix as determined by column 11. [1]	0.
60-72	D13.1	Element #3 of var/cov matrix as determined by column 11. [1]	0.
73-80	D8.2	Element #4 of var/cov matrix as determined by column 11. [1]	0.

Example 1 - Diagonal elements of variance/covariance matrix

```
 1-6     8 9  11-12      18-24     25-44    45-59     60-72     73-80
VARCOV         10       7654321     V11      V22       V33       V44
VARCOV         11       7654321     V55      V66
```

Example 2 - Upper triangular variance/covariance matrix

```
 1-6     8 9  11-12      18-24     25-44    45-59     60-72     73-80
VARCOV     1   10       7654321     V11      V12       V13       V14
VARCOV     1   11       7654321     V15      V16
VARCOV     1   20       7654321     V22      V23       V24       V25
VARCOV     1   21       7654321     V26
```

```
VARCOV          1     30        7654321        V33        V34        V35        V36
VARCOV          1     40        7654321        V44        V45        V46
VARCOV          1     50        7654321        V55        V56
VARCOV          1     60        7654321        V66
```

Where Vij represent "i"th row and the "j"th column and where the units are
as defined by the tables below.

                     Cartesian Variance/Covariance Units

     \ j   1   2   3   4   5   6
     i \   --
           |
     1 | M**2   M**2   M**2   M*M/S   M*M/S   M*M/S
     2 | M**2   M**2   M*M/S   M*M/S   M*M/S
     3 | M**2   M*M/S   M*M/S   M*M/S
     4 | (M/S)**2   (M/S)**2   (M/S)**2
     5 | (M/S)**2   (M/S)**2
     6 | (M/S)**2

                     Keplerian Variance/Covariance Units

     \ j   1   2   3   4   5   6
     i \   --
           |
     1 | M**2   M   M*RAD   M*RAD   M*RAD   M*RAD
     2 | ( )**2   ( )*RAD   ( )*RAD   ( )*RAD   ( )*RAD
     3 | RAD**2   RAD**2   RAD**2   RAD**2
     4 | RAD**2   RAD**2   RAD**2
     5 | RAD**2   RAD**2
     6 | RAD**2

UNITS: KM =Kilometers; M =Meters   ; S =Seconds   ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
        ( )=Unitless

IF CARD OMITTED: Diagonal matrix with values of 1.0D+14 will be used
```

2.5.58 YAWBIA

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
YAWBIA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	YAWBIAS: Requests for application of yaw bias	
18-24	I7	Satellite ID	
25-44	D20.8	Yaw bias	0.0 deg.
45-59	D15.3	Start time	EPOCH start time
60-72	D13.1	End time	EPOCH end time

IF CARD OMITTED: Yaw bias will not be applied.

2.5.59   DATA SELECTION / DELETION SUBGROUP

2.5.59.1 DATA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DATA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-4	A4	DATA - Indicates data reduction mode utilizing an input data file on unit 41, and introduces the data selection subgroup.	

 Note: GEODYN II asumes orbit generation type of run unless a DATA or
        SIMDAT card is present in the arc.

DATA SELECTION SUBGROUP

    The DATA card must be present in any arc which requires a data file.

    The DATA SELECTION SUBGROUP begins with the DATA card and ends with the
ENDARC card. The ENDARC card must be the last card in the arc. The DATA
SELECTION SUBGROUP consists of the following keyword cards:

 ENDARC   METDAT   OBSCOR   PREPRO   SELECT/DELETE   SIGMA

and must contain at least one SELECT card.

 IF CARD OMITTED: Program will operate in orbit generation mode

2.5.59.2 SELECT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SELECT          517603901                    830901                 830903
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                            DEFAULT VALUE & UNITS


1-6     A6        SELECT - Requests the selection of
                  observation data for the data reduction
                  process.
                  Any OBSCOR, SIGMA, METDAT, and PREPRO
                  cards that precede the first SELECT card
                  apply to all data except where explicitly
                  overridden.

7-14    I8        Station number.                                0

15      I1        Station satellite configuration                0
                  sequence number.

16-17   I2        Measurement Type. 2 digits or less.            0
                  See list of measurement types Section 5.0.

18-24   I7        Satellite ID.                                  0

25-30   I6        Measurement modulo number.                     1

31-40   D10.8     Measurement Type. 3 digits or less.            0
                  Will be converted to an integer.
                  See list of measurement types
                  Section 5.0.

41-46   I6        Start date in form YYMMDD. :          Earliest Start
47-50   I4        Start time in form HHMM.   :          date and time from
51-60   D10.8     Seconds of start time.     :          EPOCH card(s).

61-66   I6        Stop  date in form YYMMDD. :          Latest   Stop
67-70   I4        Stop  time in form HHMM.   :          date and time from
71-80   D10.8     Seconds of stop  time.     :          EPOCH card(s).


IF CARD OMITTED: No data will be selected.
```

2.5.59.3 DELETE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DELETE       517603901                    830901              830903
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DELETE - Requests the deletion of observation data for the data reduction process.	
7-14	I8	Station number. [1]	0
15	I1	Station satellite configuration sequence number. [2]	0
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0
18-24	I7	Satellite ID. [1]	0
25-30	I6	Measurement modulo number.	1
31-40	D10.8	Measurement Type. 3 digits or less. Will be converted to an integer. See list of measurement types after ENDARC description.	0
41-46	I6	Start date in form YYMMDD. :	Earliest Start
47-50	I4	Start time in form HHMM. :	date and time from
51-60	D10.8	Seconds of start time. :	EPOCH card(s).
61-66	I6	Stop date in form YYMMDD. :	Latest Stop
67-70	I4	Stop time in form HHMM. :	date and time from
71-80	D10.8	Seconds of stop time. :	EPOCH card(s).

NOTES:

  [1] Unless a specific configuration sequence number is specified on he
       col. 15, all measurements that include this station or this
       satellite will be deleted (or selected).

  [2] The station/satellite configuration number enables the user to
       delete (or select) measurement types including more than one
       station or more than one satellite without affecting other
       configurations which may include the same station or the same
       satellite.

       Here are some examples:
       In the case of measurement type 51 (two-way range) where only one
       station and one satelliteare involved, the user does not need to
       specify anything on col. 15 of the DELETE or the SELECT card.

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```

```
DELETE           517603901                    830901                  830903
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

        will delete all measurements 51 from all stations to satellite
        # 7603901 between the times 830901 and 830903.


----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DELETE     314 517603901                    830901                  830903
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

        will delete all measurements 51 from station 314 to satellite
        # 7603901 between the times 830901 and 830903.

        In the case of measurement type 61 (singly differenced one way
        ranges where we have one satellite and two stations we will need
        two DELETE (or SELECT) cards for precise specification of the
        configuration ie.



----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DELETE     3211618003201
DELETE     4212618003201
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

        This means, delete all measurement types 61 from configurations
        where station 321 is the first station and 421 is the second
        station in the configuration both observing satellite # 8003201.

        Another example is given here for measurement type 87 (doubly
        differenced one way ranges) (GPS):

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
DELETE     3211878003201                870103121956           870103122156
DELETE     4212878307201                870103121956           870103122156

DELETE     5211878003201                870103115956           870103120156
DELETE     4212878307201                870103115956           870103120156

DELETE     3211878509301                870103100156           870103100556
DELETE     4212878307201                870103100156           870103100556

DELETE     5211878509301                870103093756           870103094156
DELETE     4212878307201                870103093756           870103094156
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8


        This setup will delete all observations of measurement type 87
        with the following cofigurations:

        1.   stat 1 =321, stat 2= 421, sat 1= 8003201 and sat 2= 8307201
        between times 870103 121956.000 and 870103 122156.000
        (Cards 1 and 2)

        2.   stat 1 =521, stat 2= 421, sat 1= 8003201 and sat 2= 8307201
        between times 870103 115956.000 and 870103 120156.000
        (Cards 3 and 4)

        3.   stat 1 =321, stat 2= 421, sat 1= 8509301 and sat 2= 8307201
```

between times 870103 100156.000 and 870103 100556.000
(Cards 5 and 6)

4.   stat 1 =521, stat 2= 421, sat 1= 8509301 and sat 2= 8307201
between times 870103 093756.000 and 870103 094156.000
(Cards 7 and 8)

An efficient way for the user to find out how many DELETE
(or SELECT) cards he/she needs for each measurement type is
to look at section 5.0 in Vol 3 of the GEODYN II documentation
(Measuremebnt types). The measurement type description indicates
how many stations and satellites are involved.

Assuming we have three stations and three satellites involved,
the way to find out which goes on configuration number 1, 2 or 3
is to look at the unit 90 output of TDF. Satellites and stations
under trhe label ONE, TWO or THREE correspond to the DELETE
(or SELECT) card configuration number.

It is important for these complicated measurement types to
specify information on as many DELETE (or SELECT) cards as
the maximum number of stations or satellites involved in the
measurement type.

IF CARD OMITTED: No data that has been selected will be deleted.

2.5.59.4 METDAT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
METDAT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	METDAT - Allows input of meteorological data overriding information on data.	
7-14	I8	Station number.	0
18-24	I7	Temperature in millidegrees K.	0
25-30	I6	Relative humidity in thousandths of percent.	0
31-40	D10.8	Atmospheric pressure in millibars.	0.
41-46	I6	Start date in form YYMMDD. :	Earliest Start
47-50	I4	Start time in form HHMM. :	date and time from
51-60	D10.8	Seconds of start time. :	EPOCH card(s).
61-66	I6	Stop date in form YYMMDD. :	Latest Stop
67-70	I4	Stop time in form HHMM. :	date and time from
71-80	D10.8	Seconds of stop time. :	EPOCH card(s).

```
IF CARD OMITTED: Meteorological corrections will be obtained from
                 observation data records if present or will be defined
                 as 293.16 degrees Kelvin, 40 percent relative humidity,
                 and 1013.5 millibars scaled by the altitude in meters (H)
                 of the tracking station, P=1013.5*(1-1.1138D-4*H).
```

2.5.59.5 OBSCOR

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
OBSCOR
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS	
1-6	A6	OBSCOR - Constant bias observation corrections as provided on this card are to be subtracted from the data to which this card applies.		
7-14	I8	Station number.	0	
15	I1	Station/satellite configuration.	0	
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0	
18-24	I7	Satellite ID.	0	
25-30	I6	Measurement Type. 3 digits or less. See list of measurement types after ENDARC description.	0	
31-40	D10.8	Observation correction.	0.	M, M/S or RAD
51-60	D10.8	Observation #2 correction.	0.	RAD
71-80	D10.8	Time correction.	0.	S

```
UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED: Constant bias corrections will not be subtracted.

2.5.59.6 PREPRO

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PREPRO
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PREPRO - Requests data preprocessing. Provides a means of overriding observation data preprocessing indicators which may be in error.	
7-14	I8	Station number.	
15	I1	Station/satellite configuration.	
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0
18-24	I7	Satellite ID.	
25	I1	Indicates header record PREPRO word to which the information on the this card applies. 0 - PREPRO words on all header records 9 - PREPRO words on all Master header records n - PREPRO word on Header record number "n" (n<4).	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
26	I1	Defines default actions for columns 27-30, 41-50, and 61-70 if those columns remain blank or zero.	

Value	Action
0	Compute and apply corrections as indicated by the PREPRO word.
1	Only apply corrections already provided by the data.
2	Ignore the data block PREPRO words and apply corrections appropriate for this type data.
3	Remove corrections provided in the data.
4	Remove corrections provided in the data and compute and

```
                            apply corrections appropriate
                            for this type of data.

27-30    4I1          Switches for bits  1-4  of PREPRO word.

41-50    10I1         Switches for bits  5-14 of PREPRO word.

61-70    10I1         Switches for bits 15-24 of PREPRO word.

71-80    D10.8        Measurement Type. 3 digits or less.          0
                      Will be converted to an integer.
                      See list of measurement types after
                      ENDARC description.


NOTES: [1] Columns 27-30, 41-50, 61-70 have different meanings for different
           types of data.  However, digits specified in these columns result
           in actions being taken by the program in the same manner as
           indicated for column 26.

       [2] If PREPRO is intended to apply to all data a PREPRO
           card should preceed all SELECT cards otherwise PREPRO
           applies only to its preceeding SELECT card in the setup.



IF CARD OMITTED: The absence of a PREPRO card is an indicator that the
                 observation data is to be used as it appears on the
                 input data file.
                 With a blank PREPRO card corrections will be applied
                 as indicated by the PREPRO word on all header records.
```

2.5.59.7 SIGMA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SIGMA     7010 517603901        .10                     .25
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                     DEFAULT VALUE & UNITS


1-6     A6              SIGMA  - Permits specification of
                        observation weighting and editing sigmas.


7-14    I8              Station number.                         0


15      I1              Station/satellite configuration #.      0


16-17   I2              Measurement Type. 2 digits or less.      0
                        See list of measurement types after
                        ENDARC description.


18-24   I7              Satellite ID.                           0


25-30   I6              Measurement Type. 3 digits or less.      0
                        See list of measurement types after
                        ENDARC description.


31-40   D10.8           Observation standard deviation.    Obtained from data
                        Used in forming normal equations.


41-46   I6              Flag used to indicate if value in
                        columns 31-40 will scale the data        0
                        observation sigma or replace the
                        data observation sigma.

                          0=replaced obssig with value in
                            columns 31-40
                          1=scale obssig by value in columns
                            31-40

51-60   D10.8           Observation editing sigma. Used for   Value in cols. 31-40
                        data editing only. If this field is
                        left blank the standard deviation
                        specified in columns 31-40 will be
                        used for data editing.


Units for sigmas are :  Range - M, Range Rate - CM/S, Angles - AS


UNITS:  KM =Kilometers; M  =Meters    ; S  =Seconds    ; Kg =Kilograms
        DEG=Degrees   ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
        CM =Centimeters


NOTE : If SIGMA is intended to apply to all data, a SIGMA card should
       preceed all SELECT cards, otherwise SIGMA applies only to its
       preceding SELECT card in the setup. An example is provided here:

SIGMA          40          2.0                   2.0
SELECT                               90041300000.      900414000000
SIGMA          40          0.0                   0.0
```

```
SELECT                                          90041400000.        900415000000
SIGMA          40            1.0                      1.0
SELECT                                          90041600000.        900417000000
SIGMA          40            0.0                      0.0
```

    In the example above sigma= 0.0 will be applied to all
    measurements between 900413 and 900414 and between 900416 and
    900417, sigma= 1.0 will be applied to all observations between
    900414 and 900415, sigma= 2.0 will be applied to all observations
    between 900415 and 900416. The epoch times in this example are
    900413 and 900417.

IF CARD OMITTED: Sigma on data records will be used.

2.5.60   ARC SET TERMINATOR

2.5.60.1 ENDARC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDARC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ENDARC - End of DATA SUBGROUP and end of
                   arc indicator. Must be last card in any
                   DATA SUBGROUP section. Only the following
                   option cards can exist between a DATA
                   card and an ENDARC card: SELECT,DELETE,
                   METDAT,OBSCOR,PREPRO and SIGMA.

3 GENERAL INFORMATION ABOUT GEODYN-II

In the following section a general description is given concerning INPUT/OUTPUT files used by GEODYN-II. The IN-PUT/OUTPUT files include file names, format specifications for the scratch units and descriptions for both GEODYN-IIS and GEODYN-IIE I/O files including space allocation requirements where needed. Furthermore, the ephemeris files (GEODYN IIS UNIT 1) and the tables file (polar motion, UT1, solar and geomagnetic flux) (GEODYN IIS UNIT 2) are provided. Brief descriptions of the default gravity field file (GEODYN IIS UNIT 12) and the default station geodetics file (GEODYN IIS UNIT 16) are also given.

```
            Unit names on various computers


        Computer            Name
        --------            ----
        IBM                 FTNNF001
        CRAY                fort.N
        HP                  ftnNN

        NN = 01,02,....,99
        N = 1,2,......,99
```

3.1 GEODYN-IIS INPUT/OUTPUT FILE NAMES AND BRIEF DESCRIPTIONS

```
UNIT NO.          FORMAT          DESCRIPTION
           RECFM LRECL BLKSIZE
---------+---------+---------+---------+---------+---------+---------+---------

   1         VBS 6296 6300(DE 96)  JPL Planetary Ephemeris input.
             VBS 6620 6624(DE118)  Necessary for all runs.
             VBS 6620 6624(DE200)

   2         VBS    196   7294    Polar Motion, UT1, and Solar & Geomagnetic
                                  Flux input.
                                  Necessary for all runs.

   5          FB     80     *     GEODYN-IIS Input Control Data.
                                  Necessary for all runs.

   6         VBA    137     #     General Printer Output.

   8          FB     80           LRA correction file

  11                               Interface File output to GEODYN-IIE
BINARY       VBS      X  15476    Allocated default space of 90 tracks will hold
ASCII         FB    132  15048    4050 blocks of observations and minimal
                                  number  of parameters. Recommended
                                  space is 30 tracks, and in case additional
                                  space is needed, add 1 track per 45 blocks of
                                  observations.
                                  Space on unit 11 is a function of the number
                                  and the type of the parameters used, the
                                  number of observations and the number of
                                  blocks of observations.

  12          FB     80     *     Default Gravity File.
                                  See description at the end of this section.
                                  (Section 3.5)

  15          FB     80   3120    Default Spacecraft Area and Mass Table.
                                  (DUMMY) N/A

  16          FB     80     *     Default Station Geodetics File.
                                  See description at the end of this section.
                                  (Section 3.6)

UNIT NO.          FORMAT          DESCRIPTION
           RECFM LRECL BLKSIZE
---------+---------+---------+---------+---------+---------+---------+---------
  17          FB     80     *     Default Simulated Data Control Data
                                  See description at the end of this section.
                                  (Section 3.7)

  18         VBS      X  15476    File which contains harmonic expansion
                                  coefficients that describe the atmospheric
                                  effect on the gravity coefficients
                                  (See Vol 3 ATGRAV)

  20         VBS      X  15476    Proudman functions input file (See Vol 3
                                  OTMOD and Vol 5 Section 2.10)
```

```
   21       VBS      X  15476     Sea Surface Topography functions input file
                                  (See Vol 3 SSTMOD and Vol 5 Section 2.10)


   23       FB      80  8000      Input file for station height modification
                                  (See INSTRMNT card col. 10)


   30       VBS      X  15476     Scratch file used for planetary
                                  ephemeris processing.
                                  Allocated space of 5 tracks will hold
                                  1135 ephemeris records (32 days each. For
                                  additional n output records increase the
                                  number of tracks by ((n-1)/227)+1.



   40       VBS      X  15476     Input Observation Data file
                                  (from Tracking Data Formatter).
                                  Necessary for all data reduction runs.


   41                             Selected Observation Data file output to
BINARY     VBS      X  15476     GEODYN-IIE. Necessary for all data reduction
ASCII      FB     132  15048     runs.
                                  One track is required for every 50-100
                                  observations depending on measurement type.
                                  Default allocated space 60 tracks.


   42       U          32000     Observation Directory scratch file.
                                  Allocated space of 200 blocks of 32000 bytes
                                  each will hold 200 observation directory
                                  records. The number of observation directory
                                  records is also the number of output logical
                                  blocks of observations. For additional space
                                  the maximum number of observations per pass/500
                                  gives the number of output logical blocks and
                                  therefore the number of additional blocks
                                  required.
```

UNIT NO.	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	

```
---------+---------+---------+---------+---------+---------+---------+---------
   43       VBS      X  15476     Pass-by-pass bias scratch file.
                                  Allocated space of 10 tracks will hold
                                  2020 pass records. For additional passes
                                  increase the number of tracks by ((n-1)/202)+1


   50       FB      80  3520      Copy of setup deck scratch file.
                                  Allocated space of 6 tracks will
                                  hold information from 1428 cards.
                                  For additional n input cards
                                  increase number of tracks by n*80/BLKSIZE


   52       VBS      X  15476     Scratch files for ARC information.
                                  Allocated space should be less than or
                                  equal to the space required for UNIT 11.


   53       VBS      X  15476     Scratch files for ARC information.
                                  Allocated space should be less than or
                                  equal to the space required for UNIT 11.
```

77				File containing external sunlight ratio data to be used if called for on the SOLRAD card.
88	FB	80	15040	File containing GEODYN warnings for the TOPEX Expert Systems.
89	VBS	X	15476	File containing A1-UTC time differences
90				Debugging output file (DUMMY)
91				Debugging output file (DUMMY)
** exat##	VBS	X	15476	External attitude file. ## is the number of the arc for which the external attitude applies.

* BLKSIZE FOR FB FILES IS PROVIDED BY THE SYSTEM
** THERE IS NO UNIT NO. FOR THIS FILE. FILENAME IS SPECIFIED EXPLICITLY.
# BLKSIZE FOR VBA FILES IS PROVIDED BY THE SYSTEM

3.2 GEODYN-IIE INPUT/OUTPUT FILE NAMES AND BRIEF DESCRIPTIONS

```
UNIT NO.        FORMAT          DESCRIPTION
          RECFM LRECL BLKSIZE
---------+---------+---------+---------+---------+---------+---------+---------

   5       FB    80    3200    Debug print switch input (N/A)

   6       VBA  137     #      General printer output

   7       FB    80    3200    Updated setup ('punched') output

   8       VBA  137     #      Cartesian ephemeris printer output

   9       FB    80    8000    Terminal output (see TERMVU description)

  10       VBS    X   15476    Keplerian ephemeris printer output. VBS for
           FB   132   15048    unformatted and FB for formatted.

  11       VBS    X   15476    Interface file from IIS. VBS for unformatted
           FB   132   15048    (BINARY) and FB for formatted (ASCII).

  12       VBS 15470 15476     Observation file from IIS (DCB for binary and
           FB   132   15048    ascii).

  13       U   18944 18944     Observation random access scratch file.
                               Allocated space  equal or larger than space of
                               data set used on UNIT 12.  For additional n
                               observations increase the number of tracks by
                               ((n+5)+(n+5)*4)/18944

  14       FB    80   15040    Copy of setup deck scratch file. Allocated
                               space of 20 tracks will hold 4760 cards. For
                               cards add 1 track per 238 cards.


  15       VBA  137     #      Normal point printer report file.

  16       VBA  137     #      Preprocessing corrections printer file.

  17                           PDOUT file.

  18                           Geolocation Output file.

  19       VBS    X   15476    Observation/Residual output file

  20       VBS    X   15476    Simulation/Normal Point Generation
                               output file Space requited is the same
                               as in GEODYN IIS UNIT 41.

  27       VBS    X   15476    Proudman function Direct access file

  30       VBS    X   15476    Recommended unit for trajectory file.

  35       FB    80     *      Shadowing beginning and end times in the
                               form of DELETE cards. Used only by
                               simulated data option.
```

```
42-48    VBS   X    15476    GPS shadwing

51       VBS   X    15476    Work file for partial derivative storage
                             when forming normal equations by parts.
                             Total amount of partial derivative
                             scratch space when forming the normal
                             equations with partitioning will be
                             2*(20+NUMBER OF ADJUSTED PARAMETERS)*
                             NUMBER OF WEIGHTED MEASUREMENTS*8/15476
                             tracks.

5x       VBS   X    15476    Optional work files for partial
55                           Optical Data Auxillary file
6x                           derivative storage when forming normal
70                           equations by parts.

62       VBS   X    15476    Dstate Constraints

66       VBS   X    15476    External Ephemeris output. See Volume 3
                             - XEPHEM input card. See Volume 5
                             - Section 4.

67       VBS   X    15476    File used for the Yarkovksy model

71       VBS   X    15476    E-matrix output files (x > 0). Space
                             required is ((NUMBER OF ADJUSTED
                             PARAMETERS)**2)*4/15476 tracks.

80       VBS   X    15476    V-matrix output files. (N/A) Space
                             required is ((6*NUMBER OF ADJUSTED
                             FORCE MODEL PARAMETERS +12)*(LENGTH OF
                             ARC/OUTPUT RATE)+5*[(3*NUMBER OF
                             ADJUSTED MODEL PARAMETERS)+12])/15476
                             tracks.

88       FB   80    15040    File containing GEODYN. warning messages
                             for the TOPEX Expert System.

90       VBS   X    15476    Measurement Partial Derivative output. (N/A)
                             Space required is ((50+NUMBER OF
                             ADJUSTED PARAMETERS)*NUMBER OF
                             OBSERVATIONS)+(6*NUMBER OF ADJUSTED
                             PARAMETERS+1))/15476 tracks.

96       FB   132   13200    Unit 96 writes out station position changes
                             due to ocean loading.

97       binary              Spacecraft telemetry file.
         ieee - 64 bit binary
         on Cray

98       FB   132   13200    Unit 98 writes out station position changes
                             due to the solid tide.

99       FB   132   13200    Unit 99 writes out station position effects
                             where the station height has been modified
```

using the INSTRMNT card (col. 10).

 400   Unit 400 writes out the troposhere EBIAS and
                              the zenith path delays if the option is
                              selected on the REFRAC card.

* BLKSIZE FOR FB FILES IS PROVIDED BY THE SYSTEM
# BLKSIZE FOR VBA FILES IS PROVIDED BY THE SYSTEM

3.3   PLANETARY EPHEMERIS FILES

```
          DATA SET NAME            EPHEMERIS        TIME SPAN COVERED
---------+---------+---------+---------+---------+---------+---------+---------+


CRAY    (charney)
----


/u2/z8sgp/geodyn/support/ephmbin.data    DE200


HP    (geodesy2)
--


/geod4/geodyn/SUPPORT/ephem.data     DE200
                    ephem403.data   DE403


SUN    (Canopy)
---
/home/geodyn/support/ephem.data DE200
                    ephem403.data DE403
```

3.4 POLAR MOTION, UT1, SOLAR AND GEOMAGNETIC FLUX FILE

```
CRAY    (charney)
----

/u2/z8sgp/geodyn/support/gdntable.data


HP    (geodesy2)
--

/geod4/geodyn/SUPPORT/gdntable.data


SUN    (Canopy)
---

/home/geodyn/support/gdntable.data
```

3.5   DEFAULT GRAVITY FIELD FILE (UNIT 12)

UNIT 12 in GEODYN IIS is used as input unit for gravity field setup. Gravity information on UNIT 12 will be used unless other information is input on UNIT 05. Cards which can be input on UNIT 12 are the following:

- TITLE which contains descriptive information.
- EARTH which introduces earth constants.
- GCOEF which C and S defines coefficients in the geopotential model.
- GCOEFC which defines C coefficients in the geopotential model.
- GCOEFS which defines S coefficients in the geopotential model.

The structure of this file is such that the first card is a TITLE card followed immediately by an EARTH card and then as many GCOEF or GCOEFC and GCOEFS cards as necessary to define all of the spherical harmonic coefficients. All the GCOEFC cards should be together followed by all the GCOEFS cards. Estimation information input on UNIT 12 is ignored.

See GLOBAL SET EARTH, GCOEF, GCOEFC, GCOEFS for detailed description and format. EARTH, GCOEF, GCOEFC and GCOEFS cards on UNIT 05 override information on the same cards on UNIT 12.

3.6   DEFAULT CARD IMAGE STATION GEODETICS FILE (UNIT 16)

UNIT 16 in GEODYN IIS is used as input unit for Stations position setup. Station position information included on UNIT 16 will be used unless other information referring to the same stations is included on UNIT 05. Cards to be included as input to UNIT 16 are the following:

- STAPOS which introduces the station position subgroup

- GEODETIC which defines station geodetic information

- EXTRAGEO which specifies planetary shape parameters

- ELCUTOFF which sets station elevation cutoff angle

- INSTRMNT which sets station antenna and provides operating frequency information

- STATION COORDINATE which gives the station positions

- STATION VELOCITY GROUP CARDS (STAVEL,TIMVEL only)

- STATION EARTH TIDES COEFFICIENT CARDS (STATH2 and STATL2)

- ENDSTA which denotes the end of the station position subgroup

The structure of this file is such that the first card should be a STAPOS card and the last card is a ENDSTA card. STATION COORDINATE cards, STATION VELOCITY cards and STATION EARTH TIDES COEFFICIENT cards follow the appropriate cards of other types necessary to specify the conditions that are to apply to those station locations.

Cards which contain ajustment information (ADJUSTED, CORREL, CONSTADJ, CONSTEND) are not to be included on UNIT 16.

For detailed description see the GLOBAL SET STAPOS subgroup. Input cards included on UNIT 05 will override input cards on UNIT 16.

3.7 DEFAULT SIMULATED DATA CONTROL FILE (UNIT 17)

UNIT 17 in GEODYN IIS is used as input for the simulated data capability where observations are to be created not from real data replacement with computed observations but from generation of simulated tracking data according to the users instructions. These instructions are to be supplied in UNIT 17 as a set of input cards containing information about measurement types, station/satellite configuration, times and various other limitations. The same information may be specified on UNIT 05 instead, right after the ARC OPTION SIMDAT card. Information on UNIT 05 overrides information on UNIT 17. Data created using this capability after being checked for visibility will be output on UNIT 20 in the internal GEODYN II format and therefore they can be reintroduced later into GEODYN IIS as if they were real data.

The simulated data generation capability is introduced by including a SIMDAT card in the ARC section of UNIT 05. The ARC OPTION SIMDAT card must have a 1 on column 8, otherwise simulated data will be generated by replacing real observations with the computed ones.

The input cards in UNIT 17 (or UNIT 05) must begin with a SIMDAT card. This card is NOT the same as the ARC OPTION SIMDAT card. Its presence requests simulated data generation according to the specifications that follow. The cards which can be included on UNIT 17 are the following:

```
        SIMDAT
        SIMLIM

        SIMSAT    .
        SIMSTA    .    These cards are called the simulated
        SIMTYP    .    data configuration group.
        SIMTIM    .
        ENDCON    .

        ENDSIM
```

The sequence of the input cards is as given above. The SIMDAT card is mandatory. The SIMLIM card introduces certain limitations for the blocks of data to be generated.

The simulated data configuration group describes in five cards elements and scheduling information for the simulation. These cards are described individually in the next chapter. The last card in this group is the ENDCON card and denotes the end of this particular configuration.

The user may include as many simulated data configuration groups as desired. Finally the ENDSIM card denotes the end of the simulated data generation input.

A detailed description of all the cards on UNIT 17 is given in Section 2.6 right after the SIMDAT arc option card and right before the SOLRAD arc option card.

4 TRACKING DATA FORMATTER OPERATIONS

The Tracking Data Formatter program is designed to convert data in a variety of formats to blocked GEODYN-II binary format. (64-bit floating point format). Input to the program consists of BIH tables, a set of users option cards and data of various format types falling into one of the following categories:

1. PCE Data Format

2. GEOS-A/B Card Image Format N/A

3. GEOS-C Card Image Format

4. GEODYN Binary Format

5. GEODYN Binary Format extended for Altimetry

Chronologically ordered files containing any kind of the above data types can be input and they are block time merged. The output observation file (IUNT41) contains blocks of data sorted by measurement type and by tracking pass.

The Tracking Data Formatter includes input card processing and a limited amount of data preprocessing.

The input cards introduce certain limits and requirements for further data reduction, (special description follows).

During measurement processing input files of data are read and time merged. Furthermore they are converted into internal binary format and each preprocessing word is decomposed. Range data are transit time corrected (all time changed to ground received) and all data are changed to UTC time. Logical file blocks are formed which include one measurement type from one tracking pass per output block. Preprocessing words are composed according to GEODYN-II binary tracking data format and the Header Record as well as the Observation Records are formed for each block.

4.1 INPUT / OUTPUT UNITS

INPUT UNITS

```
UNIT #        FORMAT        DESCRIPTION
        RECFM LRECL BLKSIZE
------------------------------------------------------------------
  2     VBS   196   7294      BIH tables (same as required for GEODYN-II runs)

  5      FB   80                User option cards (see special description)

 22-40                          Data in the format specified in the FORMAT card.
                                Only six of these units can be used at any one
                                time. See FORMAT card in input option description.
```

OUTPUT UNITS

```
UNIT #        FORMAT        DESCRIPTION
        RECFM LRECL BLKSIZE
------------------------------------------------------------------
  6     VBA   137     #       Printer output giving summary of run.

 41     VBS    X    15476     Tracking data in format compatible with GEODYN-II
                             Allocated space 600 tracks.

 90     VBA   137     #       Printer output giving summary of each block of
                             data reformatted.
```

SCRATCH UNITS

```
UNIT #        FORMAT        DESCRIPTION
        RECFM LRECL BLKSIZE
------------------------------------------------------------------
 20      VBS   X    15476    Scratch file for the altimeter crossover
                             identification (could be a dummy file in
                             non-crossover runs)

 21       U         15476    Scratch file used when forming new physical blocks.
                             Allocated space of 100 tracks will hold
                             100 physical blocks. Each physical block
                             contains 236 logical records of length 10

 50      FB   80             Copy of setup deck scratch file
                             Allocated space 2 tracks.
```

4.2   TDF UNIT 5 INPUT CARDS

In the following pages a complete description of all the cards which could be used as input to the Tracking Data Formatter is given.

Information specified by these cards include format of input data, size limitations for logical blocks to be formed, a set of data select cards, an option card for normal point data and a set of cards used for altimetry data.

It is mandatory to use a FORMAT card unless GEODYN binary data are used. PASS and MAXOBS are optional cards. The Tracking Data Formatter input cards may include a DATA SELECTION subgroup similar in editing capabilities to the DATA SELECTION subgroup of GEODYN-IIS. This subgroup must start with a DATA card and end with an ENDDAT card. It may include cards for data selection and deletion limitations and specifications concerning normal points in case this option is desired.

Each individual input UNIT must be represented by its own DATA SELECTION subgroup. If DATA SELECTION conditions are the same for all input UNITS then the DATA SELECTION subgroup nmust be included after the last FORMAT card.

For altimetry data the set of ALTIM and LOCDAT cards should both be input and in the above sequence. The ENDALL card denotes the end of the Tracking Data Formatter input cards.

4.2.1 FORMAT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
FORMAT      40  0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FORMAT	
13-14	I2	Unit number for input of data in the format denoted by the number in column 17 (must be greater than 22 and smaller than 41)	40
16	I1	Type of binary data [4]	0
		0 - Binary data is old IBM format which has I*2's and R*4's.	
		1 - Binary data is new IBM format which only has I*4's and R*8's.	
17	I1	Type of Data Format Indicator [3]	
		0 - Geodyn binary	
		1 - 90 byte ASCII Range Rate Data	
		2 - Merit II SLR Data	
		3 - GEOS-3 card image - 80 byte format	
		4 - Extended Geodyn binary (altimetry)	
		5 - PCE [2]	
		6 - Extended GEOS-3 card image - 120 byte format	
		7 - GPS metric type format	
		8 - VLBI binary format	
		9 - Merit-X SLR Data from CRD reformatter	
18	I1	Extended Geodyn altimetry binary format type	
		0 - Old extended format (34, 8 byte words for a I64 machine or 38, 4 byte words for a I32 machine)	(default)
		1 - Super extended altimetry format (54, 8 byte words for a I64 machine or 58, 4 byte words for a I32 machine)	
24	I1	Time system indicator change	
		7 Converts time system indicator 7 of modified SSD data to a 3 (UTC BIH). If this is omitted epoch time scale will be considered as being ET	
30	I1	1 - Indicates altimetry data on this input unit	
		2 - Indicates crossover data on this unit	

NOTE [1]:   One format card must be present for every type of data used

in the run, unless only Geodyn binary data is used, then the
unit will default to 40. The data from the different units
will be time merged. One can also use this to merge two sets
of the same type data by inputting each set on a different
unit. No more than 6 FORMAT cards can be input.

NOTE [2]:   If PCE data is input then the FIRST record in the data
             stream on the logical unit specified by the pertinent FORMAT
             card must have a 90 in columns 2 and 3 and the satellite
             ID is columns 22-45 (format D24.16). All data following
             this card goes with that satellite. If using PCE data from
             more than one satellite then insert another FIRST record each
             time the satellite ID changes.
             See Volume 5 for the format of the FIRST record.

NOTE [3]:   For a detailed description of the various formats see Volume
             5, Section 1.0.

NOTE [4]:   This option only applies when the TDF is run on a computer
             that allows I*2 and R*4 data formats.

NOTE [5]:   Column 17 on this card should be 4 for this option.

4.2.2 GDYNEP

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+----8
GDYNEP
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GDYNEP - specifies a new Geodyn Internal Reference Time for this run	
25-30	I6	New Geodyn Internal Reference Time in "YYMMDD". NOTE	410101 (JD = 2430000.5)

```
NOTE: If YY = [51-99] the year is 19YY
      If YY = [00-50] the year is 20YY
```

```
IF CARD OMITTED:  TDF will use its default reference time
```

4.2.3 PASS

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+----8
PASS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS  FORMAT        DESCRIPTION                        DEFAULT VALUE & UNITS

1-4      A4     PASS

31-40    D10.8  Max time difference allowed between
                contiguous data records before starting            900
                new logical block  (sec)
```

4.2.4 MAXOBS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MAXOBS
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	MAXOBS	
7-14	I8	Maximum number of observations allowed in one logical block (limit=9999) (default for PCE data is 500)	1000 [1]
18-24	I7	Maximum number of output buffers per logical block.(MAXBUF) MAXBUF must be less than or equal to 100 and greater than or equal to 10	10
25-30	I6	Maximum number of scratch buffers in core must be greater than or equal to 5 and less than or equal to 500. [2]	5 200
31-40	D10.3	Bin size in seconds for normal point calculations. If this is present then a value greater than zero must be entered in columns 51-60.	
41-46	I6	Maximum internal directories that can be open simultaneously during TDF execution. Must less than 1000. [3]	500
51-60	D10.3	Minimum spacing between data points for normal point calculation runs. All data closer than minimum spacing will be discarded. If this value is present then a value greater than zero must be entered in columns 31-40. This value can be overridden for specific stations and/or measurement types if NORMPT cards are present.	

NOTE [1]:   IIS imposes two restrictions on a block of observations. No block
            can span a time period that is longer than 10*STEPSIZE, and no
            single block of observations from the TDF can be subdivided into
            more than 100 blocks in IIS. The number of IIS subdivisions is
            given by: IIS subdivisions= Number of observations in a block/
            (10*STEPSIZE/time interval between observations). If the number
            of IIS subdivisions is greater than 100, the maximum number of
            observations per block must be reduced.

NOTE [2]:   If this parameter needs to be greater than 500, please contact
            the GEODYN Group. The error in TDF if 500 is not enough reads:
            "Unit 21, attempt to read past end of record"

NOTE [3]:   Often when large data sets with many configurations are processed
            TDF stops with a message "UNIT21 attempt to read past the end of
            record" . In that case please contact someone from Geodyn

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group to help you.

4.2.5 DATA

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
DATA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS  FORMAT         DESCRIPTION                    DEFAULT VALUE & UNITS

1-4      A4      DATA   Introduces  the  data  selection
                       subgroup.
```

4.2.6 SELECT

```
----+----1----+----2----+----3----+----4---+----5----+----6---+----7----+----8
SELECT
---+----0---+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SELECT - Requests data be selected between specific times.	
25-30	I6	Minimum spacing between observations	0 sec
41-46	I6	YYMMDD - year,month,day of time to begin data selection.	
47-50	I4	HHMM - hours, minutes of time to begin data selection.	
51-60	D10.8	SEC - seconds of time to begin data selection.	
61-66	I6	YYMMDD - year,month, day of time to end data selection.	
67-70	I4	HHMM - hours, minutes of time to end data selection.	
71-80	D10.8	SEC - seconds of time to end data selection.	

NOTE: [1] For low rate altimetry data to be produced, specify the
          minimum spacing in seconds in columns 25-30.

NOTE: [2] One can use only one SELECT card per input unit.

4.2.7 DELETE

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
DELETE
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DELETE - Deletes data by either type or station	
7-14	I8	Station number - all data for this station will be deleted.	
16-17	I2	Measurement type - GEODYN I - all data of this type will be deleted.	

NOTE: One can use as many DELETE cards as necessary,
                   however any one card can indicate only one
                   station number or a measurement type.
                   If both fields 7-14 and 16-17 are non-zero
                   then the card is invalid.

4.2.8   NRMPNT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
NRMPNT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   NRMPNT - is used when normal point data
                 is being processed to designate the minimum
                 spacing between accepted data for specific
                 station and/or measurement type. All data closer
                 than minimum spacing (col 51-60) will be discarded.
                 Default value on MAXOBS card will be used if
                 no specific NRMPNT card is in for station or
                 type

7-14   I8   Station number - The minimum spacing in columns
                 51-60 will be used for all data from this
                 station.

16-17   I2   Measurement type - GEODYN I - the minimum
                 spacing in columns 51-60 will be used for
                 all data of this type.

51-60   D10.3   Minimum spacing between data points in seconds.
                 All data closer than this spacing will be
                 discarded.

NOTE: One can use as many NRMPNT cards as necessary.
                 If only the station field is present it refers
                 to all data from that station. If only the
                 measurement type field is present then it refers to
                 all data of that type. If both fields are present
                 then it refers to only data of that type at that
                 station. Cards with both fields present will
                 override cards with only station or only measurement
                 type fields defined. For this function the order of the
                 cards does not play any role.

4.2.9 ENDDAT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ENDDAT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-6   A6   ENDDAT - Indicates end of SELECT/DELETE
                 cards.

4.2.10   ALTIM

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ALTIM        10
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS FORMAT   DESCRIPTION   DEFAULT VALUE & UNITS

1-5   A5   ALTIM - Denotes set of LOCDAT cards
                 immediately follow this card.

13-14   I2   Number of LOCDAT cards that follow must
                 be at least 1 and less than or equal to
                 to 5. THIS MEANS THAT AT LEAST ONE LOCDAT
                 CARD IS NEEDED WITH THE ALTIMETRY RUNS.
                 LOCDAT cards are informational only.

4.2.11 LOCDAT

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
LOCDAT
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LOCDAT - This card is used for information only	
9-16	A8	Alphanumeric name denoting reference ellipsoid used for altimetry data.	
17-24	A8	Alphanumeric name denoting geoid on altimetry data.	
25-32	A8	Alphanumeric name denoting mean sea surface on altimetry data.	
33-40	A8	Alphanumeric name denoting orbits placed on altimetry data.	
41-60	D20.14	Semi-major axis of ellipsoid used to represent earth (meters).	
61-80	D20.14	Inverse of ellipsoidal flattening used in surface height calculations.	

NOTE 1:   At least one LOCDAT card must be included in all altimetry runs

NOTE 2:   LOCDAT cards follow ALTIM card

NOTE 3:   The number of LOCDAT cards must equal the value in columns 7-14 on the ALTIM card.

4.2.12   ENDALL

```
----+----1----+----2----+----3----+----4---+----5----+----6----+----7----+----8
ENDALL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDALL - Indicates end of unit 5 input no cards may follow this card.	

5 MEASUREMENT TYPE DESCRIPTIONS

```
TYPE
 NO.    MEASUREMENT DESCRIPTION (REV's 1.5 and later)

----    -----------------------------------------------------------------

 01     INERTIAL TRUE OF DATE "X" POSITION (S1)  [NOTE 1]
 02     INERTIAL TRUE OF DATE "Y" POSITION (S1)
 03     INERTIAL TRUE OF DATE "Z" POSITION (S1)
 04     INERTIAL TRUE OF DATE "X" VELOCITY (S1)
 05     INERTIAL TRUE OF DATE "Y" VELOCITY (S1)
 06     INERTIAL TRUE OF DATE "Z" VELOCITY (S1)


 07     OSCULATING SEMI-MAJOR AXIS                   (S1)
 08     OSCULATING ECCENTRICITY                      (S1)
 09     OSCULATING INCLINATION                       (S1)
 10     OSCULATING RIGHT ASCENSION OF ASCENDING NODE (S1)
 11     OSCULATING ARGUMENT OF PERIGEE               (S1)
 12     OSCULATING MEAN ANOMALY                      (S1)


 13     INERTIAL RIGHT ASCENSION (S1-->T1) or Laser Illum. (T2-->S1-->T1)
 14     INERTIAL DECLINATION     (S1-->T1) or Laser Illum. (T2-->S1-->T1)
 15     LOCAL HOUR ANGLE (S1-->T1)
 16     DECLINATION      (S1-->T1)
 17     AZIMUTH   (S1-->T1)
 18     ELEVATION (S1-->T1)
 19     X-ANGLE (S1-->T1)
 20     Y-ANGLE (S1-->T1)


 21     l DIRECTION COSINE (S1-->T1)
 22     m DIRECTION COSINE (S1-->T1)
 23     LANDMARK SCAN ELEMENT (S1-->T1)
 24     LANDMARK SCAN LINE    (S1-->T1)
 25     PLANETARY EDGE SCAN ELEMENT (S1-->T1)
 26     PLANETARY EDGE SCAN LINE    (S1-->T1)
 27     CELESTIAL LANDMARK S/C B.C.F. RIGHT ASCENSION (S1-->T1)
 28     CELESTIAL LANDMARK S/C B.C.F. DECLINATION     (S1-->T1)
 29     PLANETARY EDGE S/C B.C.F. RIGHT ASCENSION (S1-->T1)
 30     PLANETARY EDGE S/C B.C.F. DECLINATION     (S1-->T1)

NOTE [1]: For information on radial PCE data see volume 5, Section 1.2.

TYPE
 NO.    MEASUREMENT DESCRIPTION

----    -----------------------------------------------------------------

 31     VLBI DELAY (Q1-->T1,T2)
 32     VLBI DELAY RATE (Q1-->T1,T2)
 33     CAMERA DATA (IMAGES)
 34     LANDMARK DATA (PLANET/ASTEROID ORBITING MODE OR HELIOCENTRIC MODE)
 35
 36     DELTA-DOR ((S1-->T1)-(S1-->T2)) - (Q1-->T1,T2)
 37     ONE-WAY PLANET-EARTH RANGE   (P1T1-->T2)
 38     ONE-WAY PLANET-EARTH DOPPLER (P1T1-->T2)
 39     ONE-WAY STA-SAT RANGE (T1-->S1)
 40     ONE-WAY STA-SAT DOPPLER (T1-->S1)


 41     ONE-WAY RANGE   (S1-->T1)
```

```
42      ONE-WAY DOPPLER (S1-->T1)
43      ONE-WAY SAT-SAT RANGE   (S2-->S1)
44      ONE-WAY SAT-SAT DOPPLER (S2-->S1)
45      TWO-WAY GROUND TRANSPONDER RANGE (S1-->T1-->S1)
46      TWO-WAY GROUND TRANSPONDER DOPPLER (S1-->T1-->S1)
47      TWO-WAY EARTH-PLANET-EARTH RANGE   (T2-->P1T1-->T2)
48      TWO-WAY EARTH-PLANET-EARTH DOPPLER (T2-->P1T1-->T2)
49      TWO-WAY SAT-SAT RANGE   (S2-->S1-->S2)
50      TWO-WAY SAT-SAT DOPPLER (S2-->S1-->S2)
51      TWO-WAY RANGE   (T1-->S1-->T1)
52      TWO-WAY DOPPLER (T1-->S1-->T1)
53      THREE-WAY RANGE   (T2-->S1-->T1)
54      THREE-WAY DOPPLER (T2-->S1-->T1)
55      THREE-WAY SAT-SAT RELAY RANGE   (S2-->S1-->T2)
56      THREE-WAY SAT-SAT RELAY DOPPLER (S2-->S1-->T2)+SF*(T2-->S1-->T2)
57      FOUR-WAY SAT-SAT RELAY RANGE   (T3-->S3-->S1-->S2-->T2)
58      FOUR-WAY SAT-SAT RELAY DOPPLER (T3-->S3-->S1-->S2-->T2)+SF*
                                    (T2-->S2-->T2)
59      FOUR-WAY SAT-TARGET RELAY RANGE   (T3-->S3-->T1-->S2-->T2)
60      FOUR-WAY SAT-TARGET RELAY DOPPLER (T3-->S3-->T1-->S2-->T2)+SF*
                                    (T2-->S2-->T2)


TYPE
NO.    MEASUREMENT DESCRIPTION

----   -------------------------------------------------------------------

61     SINGLY DIFFERENCED ONE-WAY RANGES   (S1-->T1)-(S1-->T2)
62     SINGLY DIFFERENCED ONE-WAY DOPPLERS (S1-->T1)-(S1-->T2)
63     SINGLY DIFFERENCED ONE-WAY RANGES   (S1-->T1)-(S2-->T1)
64     SINGLY DIFFERENCED ONE-WAY DOPPLERS (S1-->T1)-(S2-->T1)
65     SINGLY DIFFERENCED ONE-WAY SAT-SAT RANGES   (S2-->S1)-(S3-->S1)
66     SINGLY DIFFERENCED ONE-WAY SAT-SAT DOPPLERS (S2-->S1)-(S3-->S1)
67     SINGLY DIFFERENCED ONE-WAY SAT-SAT RANGES   (S2-->S1)-(S2-->T1)
68     SINGLY DIFFERENCED ONE-WAY SAT-SAT DOPPLERS (S2-->S1)-(S2-->T1)
69     SINGLY DIFFERENCED ONE-WAY PLANETRY RANGES   (P1T1-->T2)-(P1T1-->T3)
70     SINGLY DIFFERENCED ONE-WAY PLANETRY DOPPLERS (P1T1-->T2)-(P1T1-->T3)

71     SINGLY DIFFERENCED ONE- AND TWO-WAY RANGES   (S2-->S1-->T2)-
                                                    (S2-->T2)
72     SINGLY DIFFERENCED ONE- AND TWO-WAY DOPPLERS (S2-->S1-->T2)-
                                                    (S2-->T2)
73     SINGLY DIFFERENCED THREE-WAY SAT-SAT RANGES   (S1-->S2-->T2)-
                                                    (S1-->S3-->T3)
74     SINGLY DIFFERENCED THREE-WAY SAT-SAT DOPPLERS (S1-->S2-->T2)-
                                                    (S1-->S3-->T3)
75     SINGLY DIFFERENCED THREE-WAY SAT-SAT RANGES   (S2-->S1-->T2)-
                                                    (S3-->S1-->T3)
76     SINGLY DIFFERENCED THREE-WAY SAT-SAT DOPPLERS (S2-->S1-->T2)-
                                                    (S3-->S1-->T3)
77     SINGLY DIFFERENCED TWO- AND THREE-WAY RANGES   (T2-->S1-->T1)-
                                                    (T2-->S1-->T2)
78     SINGLY DIFFERENCED TWO- AND THREE-WAY DOPPLERS (T2-->S1-->T1)-
                                                    (T2-->S1-->T2)
79     SINGLY DIFFERENCED FOUR-WAY SAT-SAT RANGES (T3-->S3-->S1-->S2-->T2)-
                                                    (T3-->S3-->S1-->S3-->T3)
80     SINGLY DIFFERENCED FOUR-WAY SAT-SAT DOPPLERS(T3-->S3-->S1-->S2-->T2)
              +SF2S*(T2-->S2-->T2)-(T3-->S3-->S1-->S3-->T3)-SF3S*(T3-->S3-->T3)
81     SINGLY DIFFERENCED FOUR-WAY SAT-TARGET RANGES(T3-->S3-->T1-->S2-->T2)-
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                                                       (T3-->S3-->T1-->S3-->T3)
  82      SINGLY DIFFERENCED FOUR-WAY SAT-TARGET DOPPLERS(T3-->S3-->T1-->S2-->T2)
               +SF2T*(T2-->S2-->T2)-(T3-->S3-->T1-->S3-->T3)-SF3T*(T3-->S3-->T3)
  83      SINGLY DIFFERENCED FOUR-WAY SAT&TARGET RANGES  (T3-->S3-->S1-->S2-->T2)-
                                             (T3-->S3-->P1T1-->S2-->T2)
  84      SINGLY DIFFERENCED FOUR-WAY SAT&TARGET DOPPLERS (T3-->S3-->S1-->S2-->T2)
               +SF2S*(T2-->S2-->T2)-(T3-->S3-->P1T1-->S2-->T2)-SF2T*(T2-->S2-->T2)


 TYPE
  NO.    MEASUREMENT DESCRIPTION
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  85      DOUBLY DIFFERENCED ONE-WAY RANGES    [(S2-->T1)-(S3-->T1)]-
                                               [(S2-->S1)-(S3-->S1)]
  86      DOUBLY DIFFERENCED ONE-WAY DOPPLERS  [(S2-->S1)-(S3-->S1)]-
                                               [(S2-->T1)-(S3-->T1)]
  87      DOUBLY DIFFERENCED ONE-WAY RANGES    [(S1-->T1)-(S2-->T1)]-
                                               [(S1-->T2)-(S2-->T2)]
  88      DOUBLY DIFFERENCED ONE-WAY DOPPLERS  [(S1-->T1)-(S2-->T1)]-
                                               [(S1-->T2)-(S2-->T2)]
  89      DOUBLY DIFFERENCED ONE- AND TWO-WAY RANGES   [(S2-->S1-->T2)-(S2-->T2)]-
                                               [(S3-->S1-->T3)-(S3-->T3)]
  90      DOUBLY DIFFERENCED ONE- AND TWO-WAY DOPPLERS [(S2-->S1-->T2)-(S2-->T2)]-
                                               [(S3-->S1-->T3)-(S3-->T3)]
  91      DOUBLY DIFFERENCED ONE- AND THREE-WAY RANGES [ (P1T1-->S2-->T2)
                          -(P1T1-->T2)]-[P1T1-->S3-->T3)-(P1T1-->T3)]
  92      DOUBLY DIFFERENCED ONE- AND THREE-WAY DOPPLERS (P1T1-->S2-->T2)
                          -(P1T1-->T2)]-[P1T1-->S3-->T3)-(P1T1-->T3)]
  93      DOUBLY DIFFERENCED TWO- AND THREE-WAY RANGES   (S1-->S2-->T2)
                          -(T1-->S2-->T2)]-[(S1-->S3-->T3)-(T1-->S3-->T3)]
  94      DOUBLY DIFFERENCED TWO- AND THREE-WAY DOPPLERS  (S1-->S2-->T2)
                          -(T1-->S2-->T2)]-[(S1-->S3-->T3)-(T1-->S3-->T3)]
  95      DOUBLY DIFFERENCED FOUR-WAY RANGES   [(T3-->S3-->S1-->S2-->T2)-
                    (T3-->S3-->S1-->S3-->T3)]-[(T3-->S3-->T1-->S2-->T2)
                                             -(T3-->S3-->T1-->S3-->T3)]
  96      DOUBLY DIFFERENCED FOUR-WAY DOPPLERS [(T3-->S3-->S1-->S2-->T2)+
                          SF2S*(T2-->S2-->T2)-(T3-->S3-->S1-->S3-->S3)-
                                             SF3S*(T3-->S3-->T3)]-
                                             [(T3-->S3-->T1-->S2-->T2)+
                          SF2T*(T2-->S2-->T2)-(T3-->S3-->T1-->S3-->S3)-
                                             SF3T*(T3-->S3-->T3)]


  97      RESERVED
  98      RESERVED
  99      ALTIMETRY
 100      ALTIMETRY CROSSOVERS
 101      DYNAMIC CROSSOVERS
 110 ALTIMETRY CONSTRAINT - LINEAR DISTANCE OF BOUNCE POINT
 111 ALTIMETRY CONSTRAINT - RADIAL DISTANCE OF BOUNCE POINT


 NOTE:

 SYMBOL   LEGEND
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   Sn    REFERS TO THE SATELLITE WHICH IS DEFINED ON BLOCK HEADER RECORD
         NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.
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Tn   REFERS TO THE TRACKING STATION WHICH IS DEFINED ON BLOCK HEADER
        RECORD NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.

Pn   REFERS TO THE PLANET ON WHICH THE TRACKING STATION Tn EXISTS.
        AN IMPLICIT REFERENCE TO PLANETARY BODIES IS MADE SIMPLY BY
        SPECIFICATION OF THE TRACKING STATION Tn. THIS IS BECAUSE EACH
        TRACKING STATION MUST BE REFERENCED TO A PLANETARY BODY WHEN
        INPUT TO GEODYN-II. THE EXPLICIT REFERENCE IN THE ABOVE MEASUREMENT
        DESCRIPTIONS TO PLANETARY BODY Pn IS DONE TO REMIND THE READER OF
        THIS FORMAT THAT THESE MEASUREMENTS ARE COMMON OR LIKELY INTER-
        PLANETARY MEASUREMENT TYPES. IN SOME INSTANCES, THE MEASUREMENTS
        ONLY MAKE SENSE WITHIN AN INTER-PLANETARY FRAMEWORK. LIKEWISE, IT
        IS POSSIBLE FOR MEASUREMENTS NOT EXPLICITLY DENOTED WITH Pn TO BE
        OF AN INTER-PLANETARY NATURE.

SFnX   REFERS TO TWO-WAY DOPPLER SCALING FACTOR FOR SATELLITE n TRACKING
        USER A SATELLITE (X=S) OR REMOTE RELAY STATION (X=T).

Qn   REFERS TO THE QUASAR WHICH IS DEFINED ON BLOCK HEADER RECORD
        NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.